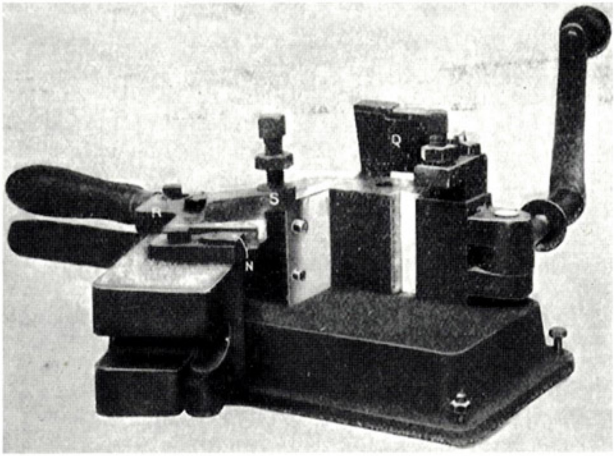
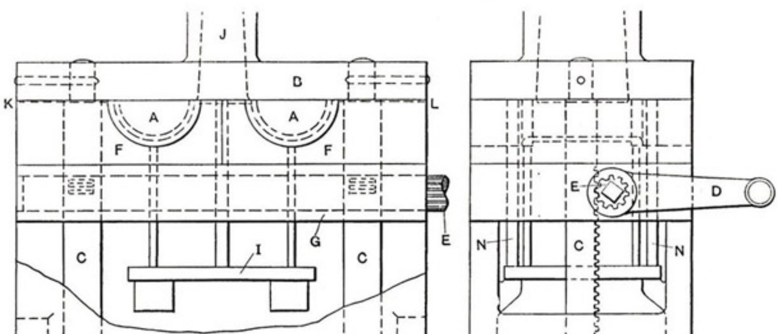


BABBITT BEARING TECHNIQUES



Machinery's Industrial Secrets

Selected articles from early issues of Machinery Magazine revealing secrets of manufacturing.

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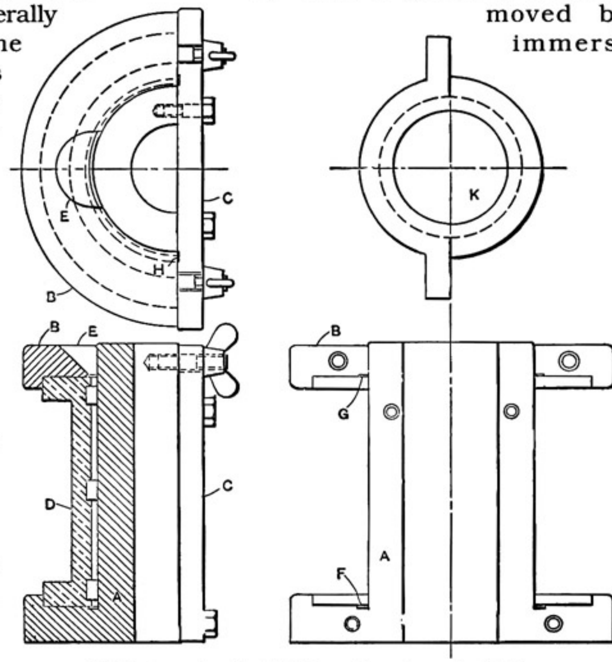
Making Babbitted Bearings In Halves

BY S. THERESA

MACHINERY MAGAZINE – DECEMBER 19, 1912

When babbitting it is usual to retain the lining either by holes or by peripheral and longitudinal grooves which are generally undercut. The writer has found after long experience that neither holes nor undercut grooves are necessary, and that plain grooves turned when the bearings are bored are sufficient if proper precautions are taken in the preparatory tinning of the bearings. Some thousands of bearings have been made in the manner to be described without the slightest difficulty.



A Fixture for Babbitting Bearings in Halves

Before the tinning, which is a dipping process, the bearings are well cleaned by buffing and by scraping in the corners. Every trace of grease is then removed by immersing them in boiling soda water. When dry, and while still warm, the parts which are not to be tinned are painted with a mix-

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Babbitt Bearing Techniques

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ture of oxide of iron and water. The inner surface is smeared with paste resin, and then the bearing is dipped into a bath of solder. If the solder does not adhere to some portions, these are further cleaned and the dipping is repeated. The bearings are then allowed to cool, and any solder adhering to the joint is removed by a touch on the disc grinder.

It must be understood that prior to tinning, the bearings have been turned and bored and the joints ground. To insure that the joint is exactly on the centre line of the hole, the bearings are bored in a fixture similar to an angle plate, with its face exactly in line with the lathe centres. Two half bearings, one having lugs, are soldered together, as shown at *K* in the illustration. The joint faces of these lugs are bolted to the face of the angle plate. After boring and cutting the three peripheral grooves, the bearings are turned to accurate dimensions on an ordinary mandrel and afterwards split apart.

As a mould for casting the babbitt, the jig illustrated was designed. It consists of a mandrel *A*, two of which are made together by a method similar to that by which the bearings are produced. Two jigs are required when the output is large. The lower flange of the mandrel and the top locating flange *B* are recessed to the diameter of the flanges of the bearings. The upper flange, having an inlet for pouring at *E*, is clamped in the manner shown, so as to be readily put into place or removed. The brass is also prevented from moving by the back plate *C* being screwed on to the mandrel; the small grooves *F*, *G*, and *H* are intended to allow some surplus babbitt at these points. It was found that the babbitt sometimes failed to run up into the sharp corners which produced a bad appearance in the finished bearing.

Prior to pouring, the jigs were slid into a small gas heating furnace, one at a time. While one-half was being poured and the finished work removed, the other was heated in the furnace to a moderate temperature, not sufficient to cause any appreciable distortion in the jig. No trace of red heat was permitted. After pouring, the small projecting parts at *F*, *G* and *H* were removed on the disc grinder. About 3/32 inch on the diameter was allowed for boring after the bearings were fitted into position in, say, a lathe headstock.

The bearings were then bored to, the exact size of the journals, or a little smaller, but never larger, as is the practice followed by some in order to reduce the scraping. Sometimes, although not often, small blowholes would show in the boring. These were simply soldered before scraping. Both before and after the final boring, the bearings were tested by hammer blows. Any sound of hollowness was sufficient reason for rejection.

The work of babbitting bearings offers considerable opportunity for the use Of different forms of fixtures that are capable of making a material increase in the efficiency with which this operation can be carried on. During the writer's experience he has had occasion to babbitt a variety of bearings, and in the following article a description is given of the different types of fixtures which he has used.

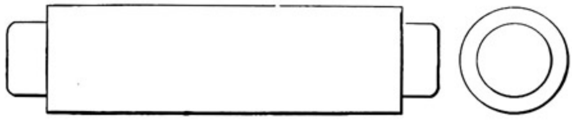


Fig. 1. A simple Form of Babbitting Mandrel

Fig. 1 shows the most common of all forms of babbitting mandrels. This is merely a piece of shafting of the required size, which is turned down at the ends to fit into the corresponding hole in the supporting plate *A*, shown in Fig. 7. This plate is a piece of cast-iron with a number of different sized holes bored in it to fit various sizes of mandrels. The body of the mandrel is turned with a taper of 0.0025 inch per foot of length in order to make it easy for the operator to remove it from the finished bearing. The mandrel is painted with a coat of thin white lead each time it is used.

Fig. 2 shows an arbor for babbitting the cap of a plain bearing. Two thin pieces of steel *A* are inserted in this mandrel, and the space occupied by these strips while babbitting is replaced by liners in the finished bearing. *B* is a projection on the mandrel which forms the oil groove in the bearing, obviating the necessity of cutting it after the babbitting operation has been completed. The fixture shown in Fig. 7 is used for clamping the bearing to the mandrel.

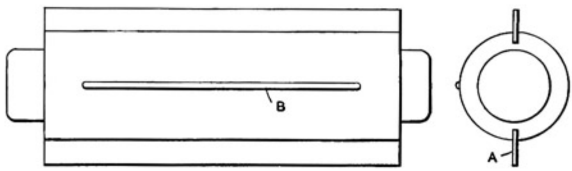


Fig. 2. Mandrel for Babbitting Plain Bearing Caps

Fig. 6 shows a rather more compli-

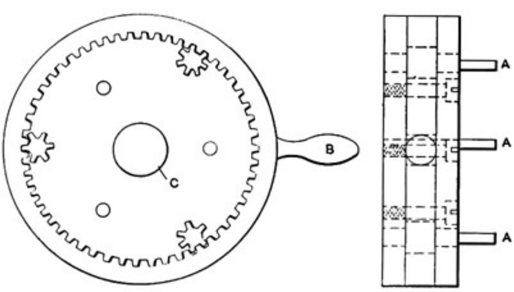


Fig. 3. Fixture used for Locating Bearing at Centre of Wheel

cated form of babbitting mandrel which is used for ring oiling bearings. The two rings A are attached to the mandrel and serve to give clearance for the oil rings in the cap. The two rings *B* are not fastened to the mandrel, but are placed in the bearing to prevent the babbitt from running out; the space around. these rings is carefully plugged up with putty before the babbitt is poured.

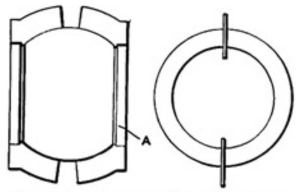


Fig. 4. Fixture for Babbitting Spherical Bearings

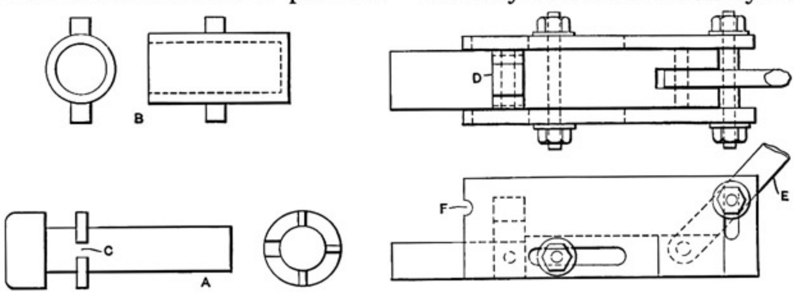


Fig. 5. Mandrel and Fixture used for Babbitting Bearing B

Bearings of this type must be babbitted in a horizontal position, the six notches cut in the sheet steel feathers being used to provide space through which the babbitt is poured.

Fig. 4 shows a fixture used for babbitting spherical bearings. In this case, the shoulders *A* are made to fit the castings as closely as possible, and any remaining cracks are carefully plugged with putty in order to prevent the escape of the babbitt. This type of bearing is babbitted in halves similarly to the ring oiling bearings, the babbitt being poured through the notches in the thin steel plates, as in the preceding case. The mandrel shown at *A* in Fig. 5 is used for babbitting the bearing *B*, which is a type that is extensively used on belt conveyors used for handling a variety of loose materials. The four notches *C* are used as sight holes for centring the mandrel in the bearing; one of these notches is cut larger than the others and is used for pouring the babbitt into the bearing. The jig shown at the right-hand side of the illustration is used for removing the bearing from the mandrel. The mandrel is placed in the slot *D* with the

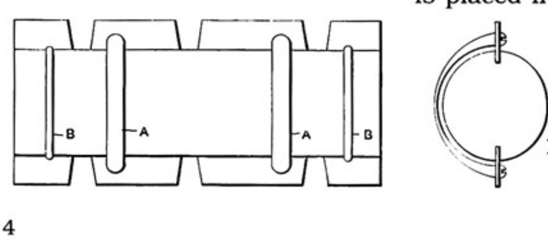


Fig. 6. Mandrel for Babbitting Ring Oiling Bearings

bearing projecting, and when the lever *E* is brought forward, the notches *F* come into contact with the lugs on the bearing and force it off the mandrel.

Fig. 3 shows a fixture for babbitting cast-iron rollers and wheels. This fixture was designed to provide a means of locating the bearing in the exact centre of a wheel; it is made in two halves with teeth cut on the inside of the ring as shown. The three pins *A* are turned eccentric with the pinions of which they are a part, and by swinging the handle *B*, the wheel is accurately centred. A mandrel of the type shown in Fig. 1 is used in connection with this fixture, the mandrel being placed in the central hole *C*.

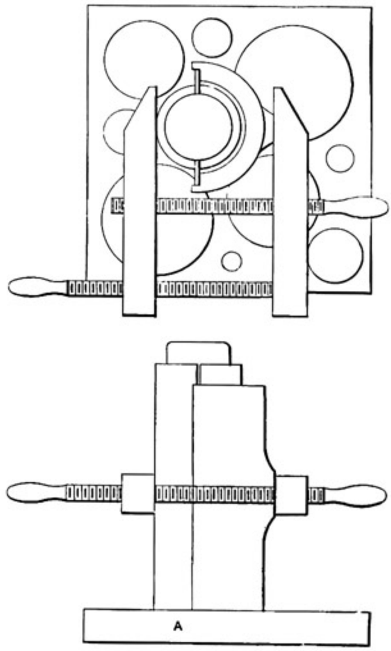


Fig. 7. Fixture for Supporting Babbitting Mandrels

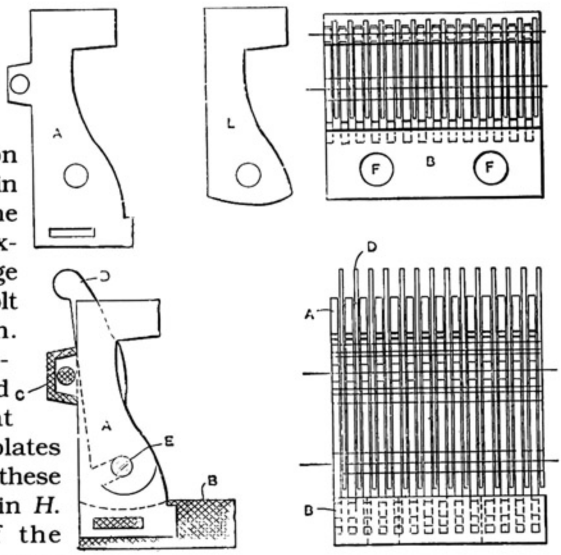
Machinery Magazine – December 26, 1912

In Fig. 1 is shown a so-called "jack-comb" used for a certain kind of textile machinery. This comb consists of a number of punched sheet-iron plates *A*, which are held together by a babbitt base *B* and a babbitt connecting strip *C*, running along the rear side of *A*. This strip also serves as a stop for the swinging pieces *D*. The latter swing around a small shaft *E* running through the entire length of the comb section. Two holes *F* are provided to fasten these sections upon a long base, one beside the other, until the desired length of the complete comb is obtained.

It is rather difficult to cast base *B* and strip *C* in such a way that all the plates are held correctly, as the latter must be exactly at right angles to the base, and parallel to, and at the same distance from, each other. Each comb plate must also be held rigidly in its position, These sections are made in large quantities and must be so babbitted that no additional finishing is required; hence, a special device is used for the work. It is the purpose of this article to, describe this babbitting device.

As shown in Fig 2 the device consists of a cast-iron base *X*

Fig. 1. "Jack-comb" for which Babbitting Device is used



having an extension or projection *G* cast in one piece with it. The right-hand end of extension *G* has a hinge *I* in which the eye-bolt *K* swings on a pin. The inner side of projection *G* is finished in such a way that the back sides of plates A fit against it when these are placed upon pin *H*. Between each of the plates *A* a distance piece *L* is placed, as shown in Fig. 1. This piece corresponds exactly, in shape, to piece *A*, except that it does not cover it at the base *B*, and at the rear extension *C*. When all the plates are in position, the top plate will be flush with the finished top surface of extension *G*. A swinging arm *M* then brings all the pieces into position. This swinging arm is clamped by the eye-bolt *K*. The steel part *U* fastened to the inside of arm *M* is shaped to suit the curved front part of the plates so as to force them into position. A crank is provided on the end of eye-bolt *K*, as shown in Figs. 3 and 4; hence, the operation is quicker than if a nut were used.

The rear side of extension *G* is provided with a bracket to which cover *Q* is attached. This

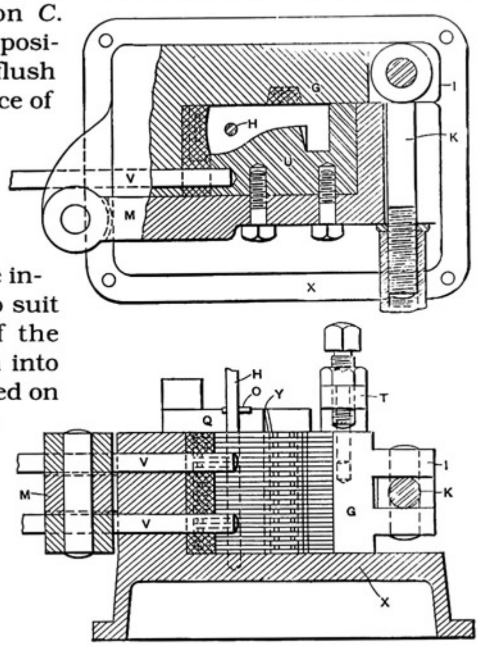
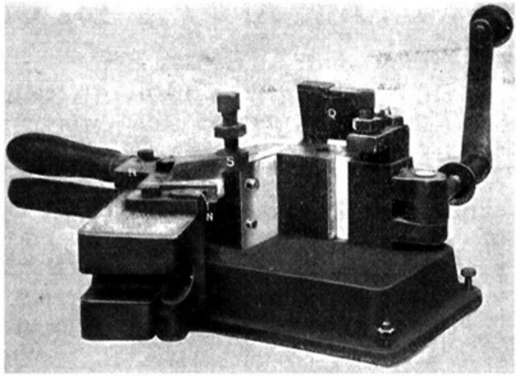


Fig. 2. Sectional Views of Babbitting Device

Fig. 3. The Babbitting Device shown Open



cover is swung out of place while the plates are being inserted, and when the column of pieces is completed it is swung over the tops of the plates. A second covering plate shown at *R*, Fig. 3, is fastened to the top of the swinging arm *M*. This plate is also provided with a projection *S* carrying a hardened set-screw which works against a small plate *O*, Fig. 2, riveted to cover *Q*, thus pressing the latter tightly against the column of punchings. Another bracket *T* is provided on casting *G*. This carries a set-screw which presses upon a second steel plate *N* fastened to swinging arm *M*. In this way the covering plates *Q* and *R* are pressed tightly against the finished top of base *X*. At both sides of the hinge for arm *M*, Fig 2, holes are drilled to correspond with the holes in the babbitt base *B*. Before the babbitt is poured in, two pins *V* are inserted through these holes far enough to be guided by two corresponding holes in piece *U*. These pins serve as cores for the holes in *A* and are provided with wooden handles so that they can be manipulated even though they may be heated by the babbitt.

After the device is filled with the plates and closed, the babbitt is poured through an opening at the top. The air escapes through the small opening *Y*. The results obtained by the use of this fixture are excellent, and no further finishing is necessary after the section leaves the device. Fixtures based on this principle may be found useful for similar jobs that may confront machine designers.

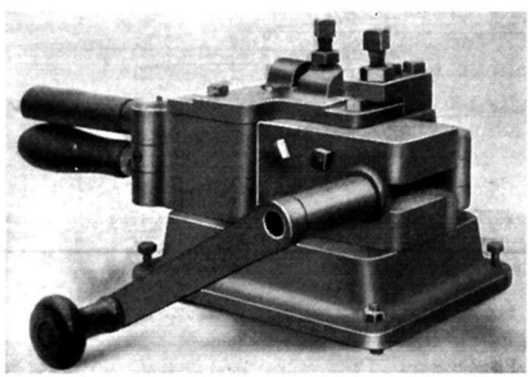


Fig. 4. The Device Closed ready for Pouring

Babbitting And Planing Cross Head Gibs

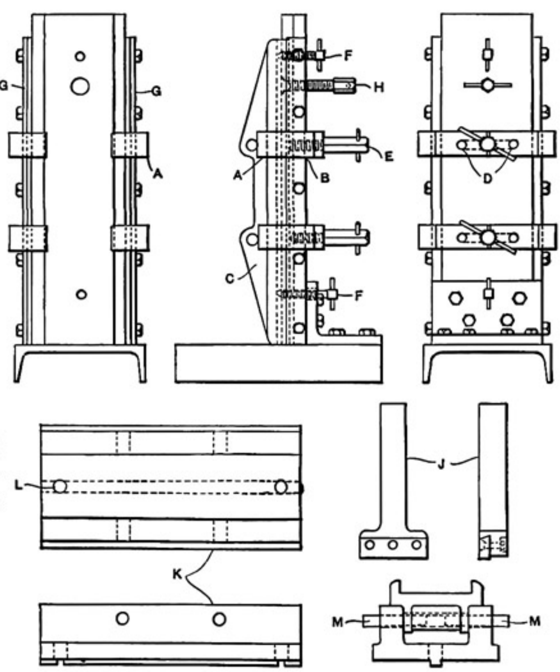
MACHINERY MAGAZINE — MAY 7, 1914

Appliances for babbitting and planing locomotive gibs, which proved very satisfactory in a certain railway shop, are shown in the accompanying illustration. The three upper views show the mandrel or fixture used for babbitting the gibs. The four U-shaped clamps *A* act as guides, and hold the gib in place while being babbitted. These clamps engage shallow grooves at *B* which are cut in the back of the mandrel body. When the gib *C* is placed in position for babbitting, as shown, the clamps *A* are pushed in against stops *D* and the screws *E* are tightened. The stops *D* are provided so that the gib will be held at the proper distance from the face of the babbitting fixture. The planed surface on the back of the gib rests against the clamps so that the face of the gib is held parallel with the fixture. Screws *F* hold the gib out against the clamps.

Before pouring the babbitt, fireclay is placed along the sides to prevent the metal from running out. This is held in place by flanges *G*. When the babbitt has hardened, clamps *A* are loosened and the gib is forced off the mandrel by the screw *H*, the side of the mandrel being slightly tapering so that the gib can be removed easily.

When this mandrel is used, the babbitt is distributed uniformly and the flanges have practically the same thickness, so that it is unnecessary to leave more than 1/16 inch of metal to be planed off. For this reason the mandrel is superior to types generally used, because it reduces the time required for planing.

The planing tool used for fin-



Babbitting and Planing Fixtures for Crosshead Gibs

ishing the babbitted surface is shown at *J*. The cutter is fastened to the holder with three small round-headed bolts as shown. The width of the cutter is slightly less than the standard width of the guide so that a gib can be planed to fit a guide which has become worn. This tool has only a slight amount of clearance on the bottom, as excessive clearance causes it to gouge into the metal. The chuck or fixture used for holding the gibs while they are being planed is shown at *K*. This fixture is held to the planer table by bolts passing through holders *L* and is aligned by a tongue on the bottom. The gib is held by taper pins *M* which are driven in through the flanges at the side, as shown in the end view. The holes in the fixture are a little lower than those in the gib so that the pins will draw the gib down firmly against the top of the chuck. The planer used for this work has a cutting speed of 50 feet per minute and the gibs are planed at the rate of 5 per hour, which is three times the production obtained before these tools were made.

H.T.P.

Babbitting Mandrels

MACHINERY MAGAZINE — AUGUST 6, 1914

The writer has given considerable time and study to the design of babbitting mandrels, and in the following article three mandrels are described which have been found satisfactory for use in babbitting bearings on a piece-work basis. The operation is satisfactory, very little defective work being produced. Fig. 1 shows assembly and cross-sectional views of a fixture for babbitting bearings of the type shown at *A*. The body of these bearings is made of malleable iron; they are rough-bored, turned and faced, and the bore recessed as shown. A very coarse feed is taken in order to produce a rough surface to which the babbitt will adhere firmly. There were a large number of these bearings to be lined, and on this account it was found desirable to use a multiple fixture, the design finally developed being equipped

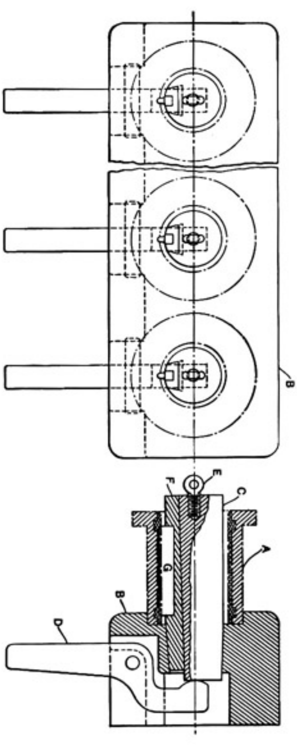
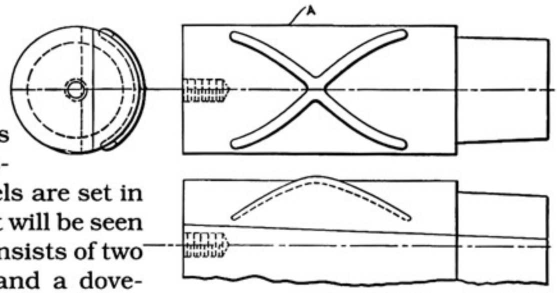


Fig. 1 Fixture equipped with four Mandrels for Babbitting Bearings with Straight Oil Grooves

Fig 2. Mandrel for Babbitting Bearings with Crossed Oil Grooves



with four mandrels as shown in the illustration. The mandrels are set in a cast-iron base *B*. It will be seen that the mandrel consists of two parts, the body *C* and a dove-tailed piece *F* which has a small block *G* mounted in it. This block forms the oil groove in the bearing. The base of the fixture is bored in such a way that the mandrel and bearing are held concentric, and after the work has been set up as shown in the cross-sectional view everything is ready for pouring the babbitt. After the babbitt has been poured and given time to set the lever *D* is struck a sharp blow; this loosens the main part of the mandrel and enables it to be readily removed by inserting a wire in the screw eye *E*. The dove-tailed piece *F* is next removed by giving it a slight tap toward the centre of the bearing. The bearing can then be removed from the fixture, and another casting set up in its place ready to be babbitted.

Fig. 2 shows a mandrel for babbitting bearings in which the oil grooves are set at an angle to each other as shown at *A*. This mandrel was made similar to the one shown in the preceding illustration and can be used in connection with the same base *B*.

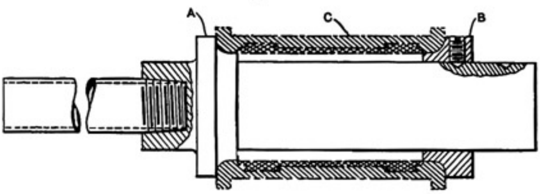


Fig. 3. Adjustable Mandrel for Babbitting Plain Half Bearings

A mandrel is shown in Fig. 3 that is used for babbitting half bearings of the type shown at *C*, these bearings having no oil grooves. The mandrel consists of a centre piece *A* which is provided with a handle made of 1/2-inch pipe at one end and a sliding collar *B* at the opposite end. The position of this collar can be adjusted for different lengths of bearings of a given diameter. It will be evident that the collar is held in position by a set-screw. The collars are turned to a close fit in the bearing castings so that they will not allow the metal to run out. These particular bearings were made of bronze castings and babbitted in the rough. The bearings were made in several different lengths, and by making the mandrel to suit the longest it may be used with

equally good results for the shorter ones.

All three styles of bearings were babbitted on a piece-work basis with entirely satisfactory results. We generally had three or four of these fixtures set up on the bench, and by having a boy assemble the fixtures while the man did the pouring, a very satisfactory rate of production was attained. The best results are obtained by having all parts of the fixture and work at the same temperature. A good method is to lay as many of the bearing castings as possible round the top of the furnace in which the babbitt is melted.

G.E.P.

Babbitting Mandrels

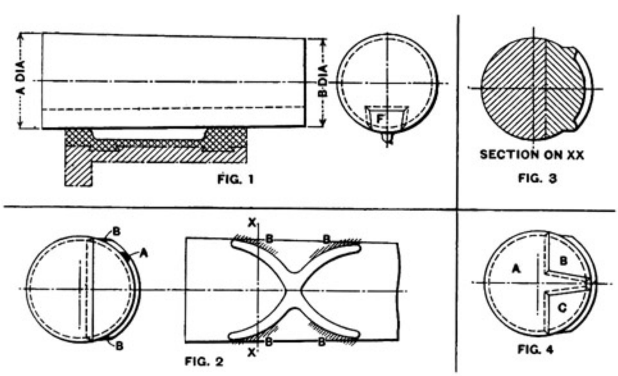
MACHINERY MAGAZINE — SEPTEMBER 24, 1914

I was very much interested in the above article by "G.E.P." page 595, August 6 issue of this journal, and in commenting on same am putting forward a few points overlooked by your correspondent.

The mandrels for the solid bearings are shown parallel, and this, due to the adhesive nature of the babbitt, makes it very hard to release the mandrel. I know of instances where the whole liner and mandrel have had to be put into the pot and melted down to preserve the mandrel. The obvious remedy is to give the outside diameter of the mandrel a suitable amount of draft, a 1/4 inch on the diameter per foot of length being good practice. This is shown in Fig. 1 here with, where diameter *A* is normal and diameter *B* equal to *A* — 1/4 inch per foot of length. It will be understood that this is considering the actual babbitted length only. A mandrel thus made, when given a sharp blow, will easily release.

The extra amount of babbitt used and the little extra machining necessary, due to the slightly taper bore in the rough, is a negligible quantity and outweighed by the easy operation of the mandrel.

The dovetail piece F, Fig. 1, page 595, is shown with back-draft only, but if draft is given to



Babbitting Mandrels

all three sides, as shown in Fig. 1 herewith, much easier release is obtained. The main point for the well working of a babbitting mandrel is draft, which should be provided at all points so that the babbitt is not given any chance to get in and bind. This is more particularly referring to mandrels for solid bearings.

Turning to mandrels provided with ribs to cast oil-grooves, the following points should be noted and the ribs so shaped as to leave no corners for the babbitt to get in and so making release difficult.

The shape shown by "G.E.P" in his Fig. 2 are semicircular in section, as shown at *A*, Fig. 2, herewith. This shape is only suitable for a straight groove. Due to its nature, a spiral rib, semicircular in section, is undercut on its outside edge about the portions *B* shown shaded in Fig. 2, this being due to the change in direction of the spiral rib. This undercutting allows the babbitt to get in at *B*, hence the mandrel will not easily "draw," resulting in the babbitt being broken away, making a badly shaped oil-grove. Of course, this may be eliminated when machined, but does not improve the mandrel, A good and well-tried shape for an oil-groove rib is shown in Fig. 3, and, as will be seen, has sloping sides. This shape easily "draws" (as will be obvious), and can be so sized as to leave the necessary size of oil-groove after the liner is machined.

Fig. 4 shows a plan view of a collapsible mandrel with oil groove ribs that is second to none. The operation is as follows: Remove the main piece *A*, when pieces *B* and *C* practically fall out. It will be seen that draft is given on all sides, making a very easy release. The behaviour of babbitt on cooling is apparently very erratic; it has been observed to remain normal, contract, and also expand. The experience of readers — with the editor's permission — on the cooling of babbitt would be appreciated.

Babbitt Bearings

Machinery Magazine — December 24, 1914

The purpose of this article is to describe a form of babbitt spindle bearing that has been found to give exceptionally satisfactory results and to explain the method of procedure followed in molding and machining bearings of this type. Fig. 1 shows one of the half bearings, and it will be seen that flanged ends are provided to take the spindle thrust. The

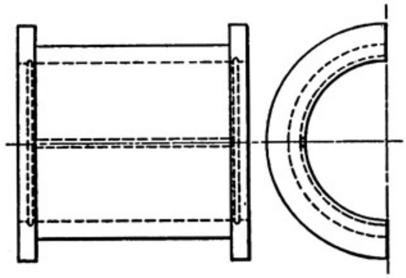


Fig. 1. One of the Babbitt Spindle Bearings

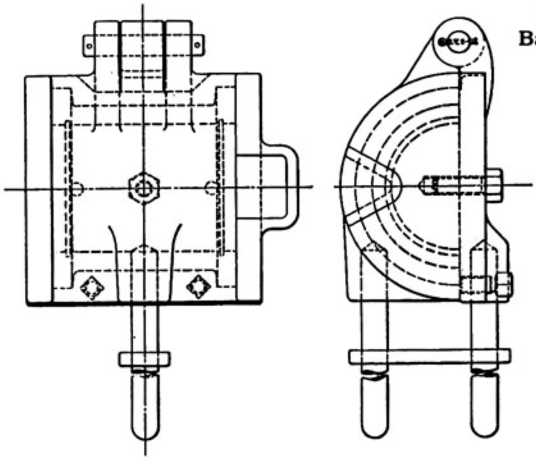


Fig. 2. Mold in which Babbitt Spindle Bearings are made

bearing is finished all over.

The mold for making these bearings is shown in Fig. 2. It will be seen that it is arranged with a semi-cylindrical mandrel secured to the base by means of cap-screws. The cover is hinged and provided with a handle for opening and closing it; and there is a second handle in the base of the mold, connected to the first by a plate with holes in it, through which the handles are slipped to clamp the cover down on the mold. The two screws in the front edge of the base are screwed down against the cover to force the cover up in case it sticks so that it cannot be easily lifted by the handle. The pocket at one side of the base is used for pouring the metal into the mold; this pocket is fairly large and allows the metal to flow freely. As this bearing is to be machined after pouring, an allowance is made in the mold to provide 1/32 inch of metal for finishing on all surfaces that are to be subsequently machined.

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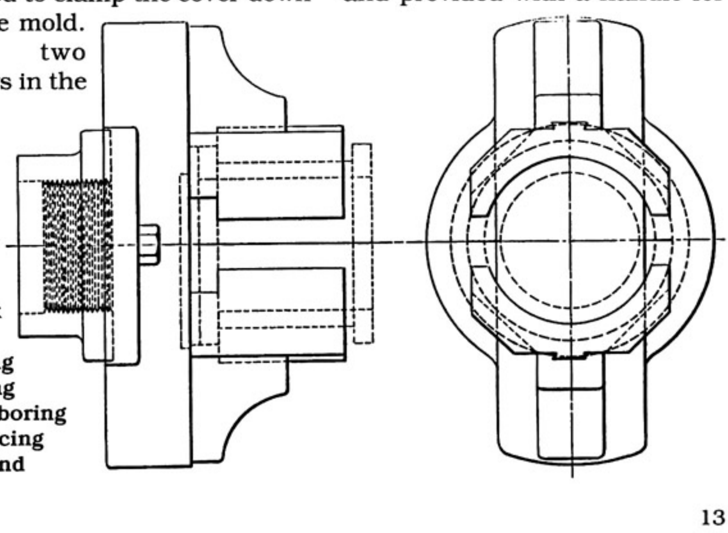


Fig. 3. Two-jaw Chuck for holding Bearing while boring and facing One End

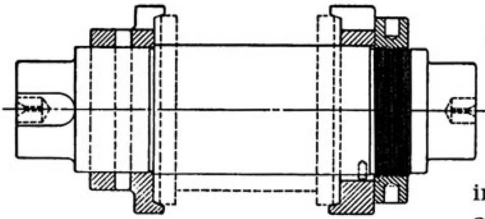


Fig. 4. Mandrel on which Bearing is held for Turning Operation

opening and closing it; and there is a second handle in the base of the mold, connected to the first by a plate with holes in it, through which the handles are slipped to clamp the cover down on the mold. The two screws in the front edge of the base are screwed down against the cover to force the cover up in case it sticks so that it cannot be easily lifted by the handle. The pocket at one side of the base is used for pouring the metal into the mold; this pocket is fairly large and allows the metal to flow freely. As this bearing is to be machined after pouring, an allowance is made in the mold to provide 1/32 inch of metal for finishing on all surfaces that are to be subsequently machined.

After the metal has been poured and allowed sufficient time to cool, the bearing is taken to the trimming press where the riser from the mold is cut off. The bottom of the half bearing is then milled off, after which the bearing is bored, and turned and faced at one end. Fig. 3 shows a two-jaw chuck with special jaws for holding two half bearings in place while they are being bored, faced and turned on the lathe. After these operations have been completed, two of the half bearings are mounted on a mandrel of the form shown in Fig. 4, ready to be turned and faced at the other end, and to have the outer surface finished. The bearings are first held on the mandrel with clamps of the form shown in Fig. 5 ready to have the end faced and turned, the nut and ring being set back to provide for handling this operation. The nut is then screwed forward against the finished end of the bearing and the clamp is removed to provide for facing the inside edges of the flanges and turning the outer surface of the bearing. After this work has been done, the bearing is completed and is ready to be assembled on the machine in which it is used.

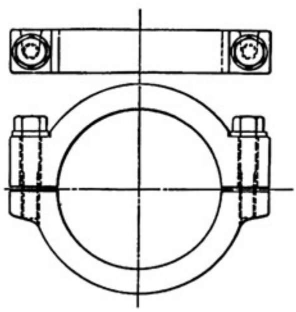


Fig. 5. Clamp for holding Two Bearings

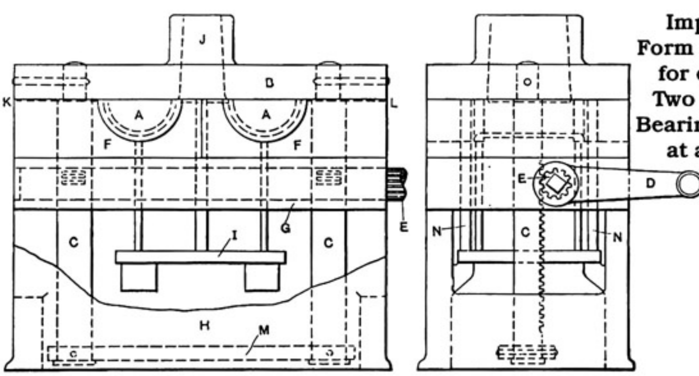
W.P.W.

Babbitt Bearing Mould

MACHINERY MAGAZINE – APRIL 15, 1915

Under the title "Babbitt Bearings" in the December 24 number of MACHINERY, a pouring mould (Fig. 2) was shown which, in the opinion of the writer, can be considerably improved and thereby produce a higher grade of castings more rapidly. It will be noted that in the pouring position of the mould referred to in this article, the bearing is horizontal and gated at the flange, and that the metal in entering the mould has a tendency to splash and divide into two or more streams. The result is that air is likely to be trapped and so produce a large percentage of porous castings. Denser castings can also be produced by increasing the height of the pouring nozzle, so that the weight of the excess metal will exert a pressure on the bearing as it solidifies and shrinks. In his experience, the writer has found that the hinged construction mould, as illustrated in the article referred to, is exceedingly unreliable. The pressure being applied at the handles, the edge along that side will always be kept tight shut; but the joint on the hinge side will have a tendency to open, the opening increasing with the wear in the hinge, and in a comparatively short time a leakage of babbitt will take place at that point.

The accompanying illustration represents a multiple mould which overcomes the defects mentioned, and is especially adapted for quantity production. The cores *A* form the inside as well as the over-all length of the bearings, and projections can be milled on them to east any desired form of oil grooves. These cores are dowelled and screwed to the cover plate *B* which is raised and lowered by the racks *C*. The racks are made of round stock with teeth raffled on a flattened surface, and are operated by the lever *D* which turns the pinion *E*. The outside of the bearings is formed in the blocks *F* which are fastened to the plate *G*, and the entire mould is



Improved Form of Mould for casting Two Babbitt Bearing Liners at a Time

mounted on a cast-iron base *H*. The shrinkage between the flanges will usually cause the castings to stick on the stationary part of the mould, and means must be provided for ejecting them. For this purpose ejector plate *I*, which in the casting position rests on four lugs of base *H*, carries an ejector pin located under each flange of the bearing. A nozzle *J* which is tapered inward directs the metal to the side of each bearing, while on the opposite sides, at *K* and *L*, openings about 0.010 inch deep and extending the full length of the bearing should be provided to permit the air to escape from the mould as it is filled.

The operation of the mould is as follows: When the castings solidify, the handle *D* is operated, thereby raising. the cover plate *B* about 5 or 6 inches. Further movement causes the strip *M* connecting the racks *C* to engage and raise the ejector plate *I* and thus eject the finished castings. When the cover plate is lowered again, it strikes against two heavy pins *N* which are mounted on the ejector plate *I*, and the latter is thus brought back to its normal position on the lugs of the base *H*. The mould is then ready for another casting.

In this form of construction only a small additional expense is involved in producing a mould for making two castings at a time. For example, the space for the outside of the bearings, which is purposely shown on two separate blocks *F*, can readily be machined at the same time by clamping them together for the boring operation. Likewise the two cores *A* can be screwed together for performing the turning and milling operations. And surely the increased production will many times offset the small additional cost of a double mould. In the operation of the mould good results will be obtained if a strong yellow gas flame is directed against the mould from time to time. A coat of carbon will be deposited in this way which helps the babbitt to flow more freely.

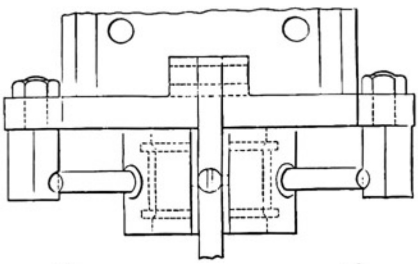
S.S.

Babbitt Bearing Mould

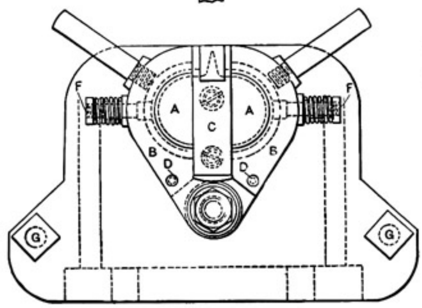
MACHINERY MAGAZINE – NOVEMBER 4, 1915

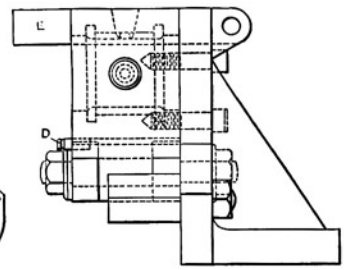
In Vol. V, page 407, and Vol. VI, page 84, of MACHINERY, descriptions were published of moulds for making babbitt bearing bushings. After reading these descriptions, the writer is inclined to believe that the mould which forms the present article is more efficient than either of the two previously described. The first cost is no greater, and it appears that this mould could be operated more rapidly and that it would be longer-lived.

Referring to the accompanying illustration, it will be seen that the main casting or frame consists of an angle block on which the cores or half-arbors *A* are mounted. The moulds *B* are



Improved Type of Mould for Use in casting Babbitt Bearing Bushings, and one of the Finished Bushings





made of least iron and are pivoted on a shoulder bolt at the bottom of the steel centre piece C. The moulds are operated by the handles at the top and are held against the centre piece by a spring which extends across between the pins *D*. When the mould is open, this spring passes below the centre of the hinge pin and serves to hold the two halves of the mould apart. The pouring is done through a hole in the centre piece E which is hinged at the back of the angle block; and a tapered pouring hole connects with the moulds through two small holes in the centre piece *C*.

After the bushings have been poured, the centre piece *E* is driven up with a light lead hammer, and in so doing cuts off the babbitt sprues extending into the holes in the centre piece *C*. At the same time this jars the bushings loose.

The piece of babbitt which is left in the centre piece *E* drops out due to the tapered opening. The mould is then opened by means of the two handles, and the ejecting pins *F* strike the post *G*. The movement of the ejecting pins is limited by collars on the stems, being just sufficient to force the bushings out of the moulds. There is, of course, a small projection of babbitt left on one side of each bushing, but this is easily removed on the disc grinder or by filing. When the mould is again closed, the springs on the ejector pins push them back to their proper positions. When the mould is open, the halves are in a nearly horizontal position so that they are easily inspected or cleaned. The entire apparatus is bolted to a bench when in use.

D.S. Mann

The Use Of Soft Metals In Machinery Construction

MACHINERY MAGAZINE — AUGUST 10, 1916

Every mechanic is familiar with the use of babbitt for the bearings of machines, but the use of soft or low melting point alloys for uniting machine members is not so well known, although it has been practised for many years. Not long ago it was common practice in the manufacture of low-priced drilling machines to fit certain brackets and pads to the sides of the column by pouring babbitt between the brackets and the column while the brackets were held in a suitable fixture. In this manner, the brackets were located in the proper position and provided with a secure bearing on the column without the chipping, filing and squaring up that were inseparable from the ordinary hand process. In the manufacture of certain shop furniture, the cast-iron shelves are made with cored holes in which the pipe legs are placed, while the shelves and legs are held in a fixture. Then a low-melting alloy is poured round the pipes in the cored holes, and when it solidifies the shelves and legs are firmly united.

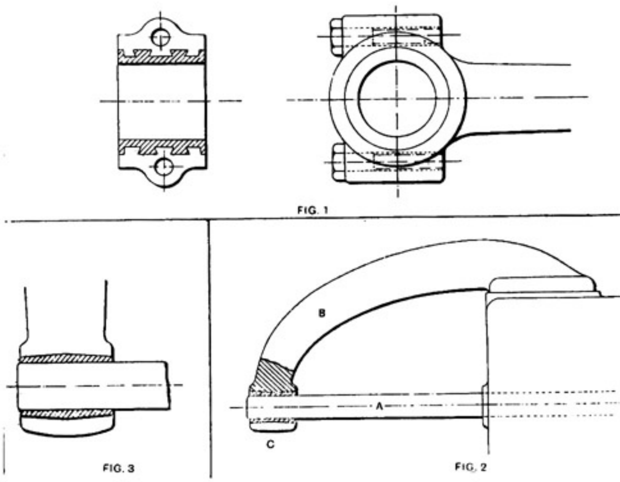
The use of type-metal to secure bearing bushings in cored machine castings, while the bushings are lined by mandrels supported in a jig, is apparently a new development in machinery construction, and one that has wide application. It permits castings to be converted into machinery with slight expense for machine work. The cast-iron bushings are bored, of course, and they may be babbitted if babbitted bearings are required. The type metal used to secure them in place is of a lower melting temperature than babbitt. Brass or bronze bushings may be secured in the same manner.

In the early days of steam engineering, sal ammoniac mixtures were used largely in engine building for the purpose of making joints and uniting parts that are now generally assembled by pressure or shrinking in. Many other examples could be cited in which cements and alloys have been used for securing machine. members. These have been looked on as cheap makeshifts unworthy of advanced practice, but the low-melting hard alloy may become a revolutionary factor in the design and construction of many kinds of machinery.

Anchoring White Metal

MACHINERY MAGAZINE – NOVEMBER 30, 1916

Many and varied are the methods employed for holding white metal in place, and to prevent it rotating after it has been



Figs. 1 to 3. Anchoring White Metal

run into place to form bearings. One of the most remarkable was that used on some aeroplane work — the work in question being the large end of connecting rods for aeroplane engines. The ends of these connecting rods had dovetail grooves turned in as shown, Fig. 1, and these grooves, for some reason, had to be kept to fairly close limits. Trouble arose through the babbit lining rotating when the engine had been running a little time. Perhaps this was only to be expected, as there were no cross slots to prevent rotation. The remedy was somewhat startling. These grooves had previously been left from the turning tool. Now they had to be polished before the babbit was run in. How a polished surface could be expected to hold babbit better than a rough one, I have not the remotest idea. Still, it is not for us mere mechanics to explore the profound depths of wisdom of the official inspectors mind.

In machine tool work, the use of babbit will frequently save expensive machining operations, as in the case of an overhanging shaft *A*, Fig. 2, which has to be supported by a bracket *B*. Accurate machining would be required to ensure the bore of this bracket being lineable with the rest of the machine. But if babbit is used, the shaft has simply to be put in place, the bracket bolted up, and the metal run in, with the assurance that the centres will be correct.

The writer has no-

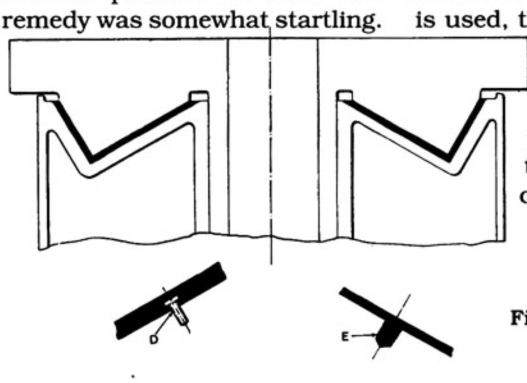


Fig. 4. Anchoring White Metal

ticed that the cored hole for running babbit is frequently made as shown at Fig. 3. Now as babbit contracts in cooling, this would not seem to be good practice, as in cooling it would tend to pull away from the surrounding cast iron. He has obtained more satisfactory results with the cored hole made as shown at *C*, Fig. 2, as in contracting, the white metal hugs the cast iron closer, and there have been no cases of the bearing working loose since adopting this method.

The use of tapped holes for anchoring white metal does not appear to be so well known as it might be. I once came across an instance where a big saving was effected by their use. As is well known, in many makes of boring and turning mills, the thrust bearing for the table is of large area, occupying a good portion of the underside of the table, see Fig. 4. With this type of bearing, the pressure per square inch is very light, and in consequence the bearing has a long life. The large area entails the use of a considerable amount of white metal, and at present prices this is a matter worthy of account. In this instance, the method of holding down the white metal was to core in a number of dovetail slots about 1 1/2 inches wide and 3/8 inch deep across the face of the bearing. In addition to this, a number of cheese-head screws were tapped in as shown at *D* to assist in keeping the metal down all over the surface. In doing this, it will be evident that only the metal above the head of the screw will be of any service, the bearing having to be cut out and poured again immediately the heads of the screws appear. So that there was a thickness of about 1/2 inch of white metal spread over a large area, which was quite useless. It was suggested that the holding down process would be accomplished equally as well if the screws were let out altogether, depending on the babbit running into the tapped holes as shown at *E*. This was done. The result was quite satisfactory, and the saving was great, as less than half the amount of white metal was required to do the job.

Lining Bearings With Babbitt Metal

Machinery Magazine – March 1, 1917

Cleaning the Shell

Cast Iron, Malleable Iron, or Cast-steel Shells (Untinned). — Remove all the old lining from the shell. This may be done by heating the shell sufficiently to melt out the old lining. Remove all oil, dirt, or other foreign matter by dipping the shell in a solution of caustic potash or by burning. If the burning method is used, continue the burning until all smoke ceases, showing that all oil and dirt have been burned off; then scrape the surface with a file and rub down with coarse sand-paper in order to remove all scale and oxide.

Bronze, Pipe, or Steel Shells (Tinned). — Remove the old lining by heating, preferably in a pot of scrap babbitt, and be sure not to heat above 375 deg. C. Just as soon as the old lining is melted out, swab the tinned surface With zinc chloride (a saturated solution of zinc in hydrochloric acid), then dip into a pot of "half-and-half" solder, which should be kept at a temperature not less than 340 deg. C. and not more than 375 deg. C. If shells are to be babbitted immediately, do not touch tinned surface after removing from the solder pot. If the shells are to be allowed to cool, brush off the tinned surfaces with a piece of clean waste.

Tinning

Bronze or Steel Shells. — Paint the parts not to be tinned with a thin mixture of graphite and water. When dry, swab the parts to be tinned with zinc chloride, then dip the shell into a pot of "half-and-half" solder, which should be kept at a temperature not less than 340 deg. and not more than 375 deg. C. Leave the shell in the solder until it is just hot enough for the solder to run off, leaving a thin coating. Remove the shell from the pot and rub the surface to be coated thoroughly with a swab saturated with zinc chloride, then dip in solder again to wash off all traces of zinc chloride. If any untinned spots can be detected on the surface to be babbitted, repeat the operation. If shells are to be babbitted immediately do not touch tinned surfaces after removing from the solder pot. If the shells are to be allowed to cool, brush off the tinned surfaces with a piece of waste. Steel shells must be pickled to remove the scale before being tinned.

Preheating of Mandrels and Shells

Iron or Steel Shells (Untinned). — Preheat the mandrel to a temperature of approximately 150 deg. and the shell to 100 deg. C. If the shell is heated too hot, the length of time for cooling may be so prolonged that the heavier metals in the babbitt will have time to settle to the bottom end of the bearing, in which case the metal in the one end of the bearing will be soft and in the other end brittle, while if the shell is too cold it will cool the babbitt too suddenly and cause it to shrink away from the shell. After each bearing is poured swab off the mandrel with a piece of waste which has been dampened with clay wash. Tiffs leaves on the surface of the mandrel a thin layer of fine clay dust, which has been found to be of great assistance in producing smooth, clean bearings free from pin-holes and other surface defects.

Bronze or Steel Shells (Tinned). — Preheat the mandrel to about 100 deg. C. The same reasons for having the temperature correct apply here as given under "Preheating of Mandrels for Iron or Steel Shells." After each bearing is poured it may be found necessary to. cool the mandrel. This is done by dipping

it in a clay wash, which leaves a layer of fine clay dust, the same as the swabbing for iron and steel shells. When the mandrel is at the proper temperature the water of the clay wash will evaporate very quickly on the surface of the mandrel, but will not spatter vigorously. The brass shell is preheated in the tinning operation, and should be babbitted immediately after it has been tinned, before losing the heat given to it by the tinning operation.

Melting

Melt the babbitt in an iron pot or kettle, and maintain at a temperature between 460 deg. and 470 deg. C. It is very necessary that this temperature be maintained when pouring in bearings, and that the upper temperature of 470 deg. C. be not exceeded at any time, as in certain grades of babbitt the metal is irreparably damaged if this temperature is exceeded. The use of an automatic regulator is necessary to hold the temperature within these limits. Stir the metal thoroughly at frequent intervals, otherwise the heavy metals will settle to the bottom of the pot. Keep the babbitt metal covered with charcoal or graphite to prevent oxidation.

Pouring

Pour from a ladle in a steady stream directly down along the mandrel to avoid splashing or pocketing of air. The lip of the ladle should be kept free from burrs or other surface irregularities in order to pour a smooth, round stream. If the metal is splashed up against the mandrel it will cause blow holes and give a mushy bearing.

In brief, pouring temperature for babbitt — 460 deg. to 470 deg. C.

Temperature of "half-and-half" solder for tinning — 340 deg. to 375 deg. C.

Preheat iron and steel shells — 100 deg. to 150 deg. C.

Preheat bronze shells in tinning operation.

Preheat mandrel for iron and steel shells — 100 deg. to 150 deg. C.

Preheat mandrel for bronze shells — 100 deg. C.

Babbitted Machinery Construction

MACHINERY MAGAZINE – MARCH 15, 1917

The article entitled "Babbitted Machinery Construction" that appeared on page 272 of Vol. IX. of MACHINERY is both interesting and timely, and graphically illustrates a common mistake made by many engineers and designers, either through prejudice or a desire to follow the trend of the times. That a good babbitted bearing is to be preferred to a poor bronze one goes without

saying. The experience of many years has proved that a babbitted beadng, property lubricated, gives a low co-efficient of friction and long life as well.

It is common practice to babbitt the main bearings of marine engines, and this material gives entire satisfaction, notwithstanding the enormous weight of the crankshaft and other parts, connecting-rods, crossheads, pistons and piston rods, to say nothing of the extra weight brought to bear by the steam pressure. Yet a marine engine must run continuously from the time the ship leaves the port until she docks again, for it is exceedingly dangerous to stop a ship for repairs when there is a heavy sea running. Marine-engine main bearings that are babbitted often run for many years without attention, aside from a little scraping and adjustment of liners, and when they are worn to a point that demands renewal, they are replaced at a comparatively trifling cost.

In the past, many machine-tool builders employed babbitted bearings in lathes, screw machines, small milling machines, etc., with very satisfactory results. In such cases, the babbitt is poured over a mandrel somewhat smaller than the desired finished size and later is thoroughly peened. The bearings are then bored and line-reamed. This method gives excellent results, as any mechanic of the older school can testify. Yet the purchaser of machinery at the present day looks askance at a good, honest babbitted beating, thinking that it is a sure sign of cheap construction. One"concern that obtained excellent results with babbitted bearings made semi-automatic machines for folding collar blanks, preparatory to stitching, that had several shafts connected by gearing. These shafts were carefully lined up by means of templets and then babbitt was poured in the journals. As the spacing of the shafts had to be fairly close, because the gears had to mesh properly, considerable money was saved by this method; for otherwise it would have been necessary to bore the frames very carefully, or make expensive jigs.

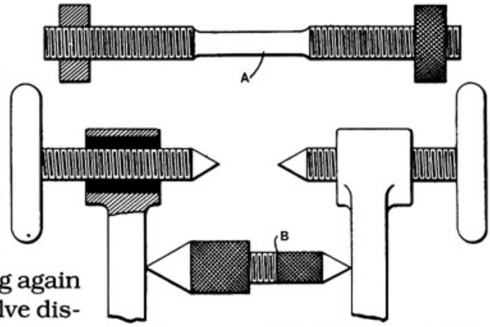
The babbitted bearing has earned for itself an established place in the mechanical world, and engineers, designers and those who contemplate the purchase of machinery should investigate its merits before hastily condemning it as little better than a makeshift, or, at best, a short-cut toward a desired end.

F.B.J.

Alignment Babbitting

MACHINERY MAGAZINE – APRIL 19, 1917

One of the advantages babbitt possesses is the sterling advantage of giving an easy method of exact alignment, utilizing the journal, set fair, for a mandrel. Subsequent bedding in is a quick



and easy operation involving minimum time.

Such practice is not altogether without drawbacks. For example, in a case of considerable wear, alignment has to be restored. To run up a beating again with alloy metal may involve dismantling an important machine and the consequent expense entailed. On the other hand a gunmetal bush is often much the easier to replace under repair conditions and with the minimum of delay and expense.

In the application of babbitt illustrated herewith, the cone-pointed screws, with hand wheels shown in place, form part of a truing device for motor cycle and other wheels. The retail price is kept very low (actually under 20s.). The remainder of the main casting, not illustrated, consists of a base with two limbs, of which the portions shown are at the top. The actual gap is about 16 inches deep. The whole device is very light. Like lathe centres the cone points must be true both from necessity and because anyone can easily spot inaccuracy by rotating or bringing the points close together. Alignment is also important. The points must adjust on a line representing their centres and the axis of both screws.

Using normal methods of machining the spring of the limbs presents no small difficulty, owing to any distortion showing as inaccurate when the job is assembled. It would be necessary to drill undersize, bore and ream and then thread with a long tap through both holes. Even so, and taking the greatest care, it is well nigh impossible to prevent distortion while tapping, or the chance of fracturing the casting itself. Added to this there is strong probability that the points would show relative movement after machining, so that babbitt is the only means of ensuring the combination of accuracy and economy.

The mandrel *A* is placed through the two cored holes which are of the same size, the bridge piece *B* serving to preserve the distance apart of the two limbs. The mandrel is gently tapped reasonably fair to the centre of the holes, and metal is poured from the inside faces. It is difficult to see how in view of the circumstances the method can be bettered. The finished job is accurate and lineable and affords considerable life to the apparatus. In reviewing the matter it seems possible that the method is worth some further application. If a cast-iron nut of about half the usual thickness be placed on each end of a

screwed test specimen of mild steel, it is just a question as to whether the nuts will burst or the bar be broken. The assumption is therefore fair, that the normal nut is in excess of the bolt for strength, This being the case, there is little doubt that a babbitted thread, say two diameters long, surrounded by a stiff casting and not subject to wear, is of sufficient strength for many purposes. A cored hole, especially if tapered in the reverse direction to the pull, has sufficient irregularity to key the metal. Tapping and drilling are cheap operations where conditions are normal. There are, however, cases where accuracy of location is a fundamental point, where both drilling and tapping are exceedingly difficult if not downright impossible in situ.

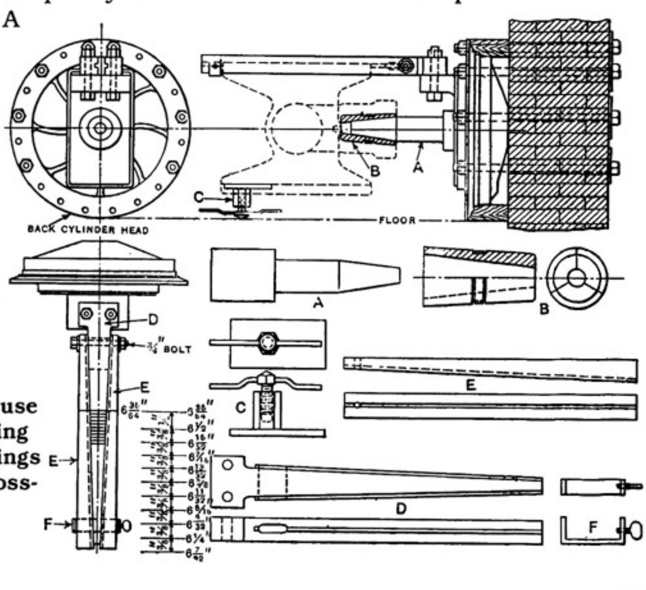
The instance cited may therefore solve an awkward problem occasionally met with in a new job, and much more frequently experienced under repair conditions.

A. L. Haas

Babbitting Solid Cross-Heads

MACHINERY MAGAZINE – FEBRUARY 14, 1918

For the benefit of fellow employees in railway shops, I wish to describe a method of babbitting the guide bearings of solid cross-heads that has been the means of reducing labour and increasing the quality of workmanship, A back cylinder head is bolted to the wall of the shop and held away at the proper distance by means of wooden blocks. The large end of plug *A* is next put into the hole in the cylinder head, which is counterbored to receive packing and accessories. After this, an adjustable bushing *B*, which is made in three parts and held



Fixture for use in Babbitting Guide Bearings of Solid Cross-heads

together by a spring band, is put into the piston-rod end of the cross-head. The crosshead is then lifted so that bushing *B* can be slipped over the tapered end of plug *A*. A jack *C* provides for accurately adjusting the height of the cross-head so that it is. supported in a perfectly level position.

After the work of setting up has proceeded to this point, pieces *D* and *E*, which are adjustable for width, are put in place and set to the proper width to suit the guides of 'the' locomotive-on which the cross-head is used. It will be seen that the side pieces *E* are held to centrepiece *D* by means of a 3/4-inch bolt. This bolt passes through a slot in centre piece *D*, so that side pieces *E* can move the bolt in order to make proper adjustment for the width of the guides on the locomotive. As indicated by the scale, this adjustment covers a range of from 6-7/32 to 6-35/64 inches. The pieces *D* and *E* are held in place at the outer end of the cross-head by means of clamp *F*. When the work has been set up in this way, babbitt is poured into the guide bearing, and after one bearing has been babbitted, it is a simple matter to turn the cross-head over and set the fixture up for babbitting the second bearing.

Lining Cast-Iron Bearings With Babbitt Metal

MACHINERY MAGAZINE – MAY 12, 1921

H. — I shall be glad to have practical and precise details of the most economical way of cleaning and babbitting castiron bearings before trimming; also particulars of the method for copperizing. (ANSWERED BY W. R.)

It is not clear from the wording of the query above whether or not the bearings or shells are in the rough or machined state before the babbitting operation; but as rough cast shells are sometimes required to be babbitt lined, the writer will include this class in the present. article.

In the first instance, assuming the castings are received in the rough state direct from the foundry, it will be necessary to remove the sand by tumbling, and the scale by means of an acid 'bath. The container for the acid may be made of wood, and lined with lead, and of a size suitable to the work in hand. A strong grating of wood should be provided to fit the tank or bath; this grating will allow all loose sand and scale to fall to the bottom of the bath. The grating must be constructed entirely of wood, no metal plates or nails of any kind may be used. Where weight considerations permit, the grating may also.be used for raising the castings from the liquid in the bath. The acid solu-

tion used for pickling the iron castings is made up as follows :-

Sulphuric acid .... 1 part.
Water .... 5 parts.

This solution acts upon the iron, and removes sand and scale bodily by undermining.

Another acid bath for pickling iron castings for the removal of sand and scale is composed of :—

30% hydrofluoric acid ... 1 part.
Water .... 20 parts.

This solution acts in a different manner altogether :to that previously given; the hydrofluoric acid dissolves the sand and scale, while attacking the iron but slightly. Either of the above solutions will clean a casting free of sand and scale in about one hour.

Where a number of castings have to be pickled, it will be found advantageous, and economical, as far as the acid is concerned, rouse weaker solutions, as follows :—

Sulphuric acid .... 1 part.
Water .... 15 parts,

or

30% hydrofluoric acid ... 1 part,
Water .... 60 parts.

With either of the above weaker solutions the castings may remain immersed for a whole day or night.

It is essential when using either sulphuric or hydrofluoric acids that great care be taken to avoid burns, especially with the latter. The acid should be poured very gently into the water, stirring the water briskly the whole of the time. Rubber gloves should be worn by the operator while handling these acids, and in the event of acid coming into contact with the skin, it must be washed off immediately with clean water and dilute ammonia.

The above solutions may be advantageously used hot; the strength of the solution is kept up by adding acid for each batch of castings. After removal from the acid bath, the castings are immediately immersed in a hot solution of water and potash or soda, in order to neutralize the acid still remaining. upon the castings. For this solution use about one pound of potash or soda to the gallon of water. The castings are next transferred to a tank of clean boiling water, and as this is the final washing, the water should be changed frequently to eliminate the soda carried over from the previous bath. Hot water is necessary to ensure the castings drying quickly; this, of course, helps considerably to minimize the danger of rusting.

Assuming now that the shells to be babbitted have been thoroughly freed of scale or rust by the above methods, or by mechanical means, such as filing, chipping or turning, the actual work of babbitting may be proceeded with. It is not an easy matter to babbitt cast-iron

shells, and the operation preceding the babbitting — the tinning — is very difficult compared with the tinning of gun-metal shells. Shells too large to be dipped into a bath of molten tin may be tinned by the following method. When the shell is thoroughly cleaned on the surface required to be tinned, it is heated in a furnace, or by means of a blowlamp, applying the flame on the outside of the shell, to the temperature of melting tin, say 450 deg. F., and a stick of pure tin is rubbed. over the whole surface, using sal-ammoniac as a flux. A thin coating of tin may be deposited in this manner, care being taken to cover the whole surface where the babbitt is required to adhere. Zinc chloride maybe used as a flux, if preferred. After tinning, as above, wipe out all superfluous tin, using tow or hemp for the purpose, and then go over the tinning again, either with pure tin, or with half-and-half solder. Wipe clean again, and remove all traces of the flux, otherwise blowholes will develop in the babbitt afterwards. When tinning the shells, great care should be taken to avoid the flame reaching the surface to be tinned; the tin must not be overheated, or trouble will develop through oxidation; and both before and after tinning, the surface must not be touched by the hand.

It is well to remember that many of the babbitt or white lining metals may be used for the actual tinning operation, The Hoyt Metal Co. supply strips of metal for this purpose, as well as a special flux for use when tinning cast-iron shells; these remarks do not apply to all white metals, however, or even to all the Hoyt metals, some of which must be used with a tinned surface. When in doubt, therefore, use pure tin, or good quality tinman's solder. The method of applying the white metal for tinning purposes is exactly as described above for tin or solder.

Where facilities are available for tinning the shells by dipping, the surface to be tinned is thoroughly cleansed, while the part not to be tinned is coated over with a thin paste consisting of graphite and water. When quite dry, the clean surface is swabbed with zinc chloride, then dip the bearing into a pot of half-and-half solder, the temperature of which should be at least 500 deg. F. retain the bearing or shell in the molten bath until it is hot enough for the solder to run off, thus leaving a thin coating upon the whole surface. The shell is then wiped free of superfluous solder, swabbed with the flux, and dipped again into the molten solder. The excess solder is then wiped off, and the shell is dipped into clean water, and thoroughly washed, to remove all traces of the zinc chloride. A potash bath is often used for this purpose, as the potash neutralizes the acid, the presence of which causes blowholes in the babbitt.

Extraordinary pains are sometimes taken to ensure clean tinning, more especially where

large numbers of bearings and connecting rods are being handled. It is the presence of carbon in cast iron which makes the tinning such a difficult matter, and in some instances the carbon is chemically removed by heating the castings in a box for a few hours, the box being packed with oxide of iron. The oxides give up oxygen, which combines with the carbon in the iron to form a gas. After decarbonizing in this manner, the iron castings are pickled in a solution of sulphuric acid for a short period, after which the surface is tinned by dipping, or other means, 'using sal-ammoniac' as a flux. It will be found advantageous to pre-heat the castings before tinning; this must be done carefully to avoid oxidation of the surface; the film produced absolutely prevents the tin or solder adhering.

When shells are produced in large quantities it is good practice to provide potash or soda baths in which the castings are immersed, after machining, in order to remove grease, they are then thoroughly washed in clean boiling water, and in some instances scoured with clean water and sand by means of a revolving brush. After the tinning operations, performed by as many as three different dippings; first in pure molten tin, and then in solder, the potash bath and the clean water bath are again requisitioned, to remove any remaining flux. The melting of the babbitt metal is accomplished in an iron pot, and. in this important matter extreme care must be taken to obtain the correct temperature for the particular brand of metal used. The correct temperature varies with different grades and makes of white metal; and in all cases the makers instructions should be strictly adhered to. A well-controlled furnace, gas or electric for preference, is essential for tile attainment of uniform results, and economy in metal, where a large number of bearings are handled. During the melt the metal should be stirred frequently; the heat should be applied gently, and checked when once the whole of the metal is molten. A layer of charcoal or graphite covering tile surface of the molten metal will prevent oxidation.

Before pouring the babbitt metal, the shell must be heated to a temperature at which the tinned surface begins to run; this will ensure cohesion between the tinned surface and the babbitt metal. The mandrel also should be preheated to about 200 deg. F., and after each pouring it will be well to reduce its temperature to this point. A good method of cooling is to plunge the mandrel into a bath of water with which some clay has been mixed; this procedure results in a fine film of dust being left on the mandrel; this layer of dust prevents the white metal adhering or sticking to the mandrel, and at the same time gives a very fine finish to the bearing surface. A babbitting jig designed to ensure perfect alignment between the shell and

the mandrel is essential when a number of similar bearings are being put through. It will be found advantageous to make the mandrel from steel tubing, made to the exact diameter of the required bearing, either by turning or grinding, or both. This class of mandrel allows the bearing to be chilled after pouring, which considerably improves the quality of the surface of the white metal, and ensures long life.

Assuming a suitable jig is used, the shell and mandrel are secured in position on it, and the whole rig is placed over a Bunsen burner or gas ring, and the whole heated up to the point where the tinned surface begins to run. A ladle, sufficiently large to hold the required amount of white metal for the bearing, is now filled at the pot, which should have had its contents briskly stirred, a moment before the ladle full is taken out, and the filling of the bearing is carried out. The ladle should be so designed that it will give a smooth, round stream; the pouring should proceed gently, but without loss of time; avoid splashing, otherwise the surface of the bearing will not be clean and smooth. Splashing is one of the causes of blow-holes and bubbles, due to the splashed particles upon the shell and mandrel failing to become homogeneous with the body of the metal after the latter has enveloped them. In every case where at all possible the bearing should be cast on end. During pouring, a clean wire or rod pushed in and out of the metal in the shell will greatly assist in the removal of air, thus preventing blow-holes. Whenever circumstances permit, it is good practice to have a kind of riser, that is, the white metal should be allowed to project 1/8 or even 1-inch above the actual height of the lining, to give a head to the metal, helping to remove air; and any sinking of the metal, during cooling, will take place in the riser, instead of in the actual lining.

After pouring the lining, the top should be kept hot by means of a blowlamp until all sinking has ceased. The whole bearing should then be cooled from the bottom upwards. This can be accomplished by playing a cold blast, or a stream of water, upon the bottom end of the shell, gradually rising with the blast or stream until the top is reached. It is not difficult to arrange for the whole jig, with the bearing, to be gradually lowered into a bath of cold water; or water may be allowed to rise slowly around the shell and up the mandrel simultaneously, care being taken that no water reaches molten metal. Chilling as above will result in a very solid, or dense body of metal in the lining, the wearing qualities of which will surpass babbitt bearings otherwise treated.

In the case of bearings or shells which require refining after service on a machine, it will be necessary thoroughly to cleanse these of oil, grease and dirt, in the hot soda bath (but not in the bath to be used in con-

nection with the tinning operations). Caustic soda is used, the solution being of the strength given by about one-half pound or more of soda to the gallon of water. This is used at boiling heat, and after a short time in the bath the bearings will be found quite clean.

The old babbitt lining is next melted out, using a pot for this purpose, after which the inside of the shell, if tinned, should be carefully wiped out. A new layer of tin will be required in the shell before it can again be lined with the white metal. In the re-tinning operation care should be taken to ensure the new tin actually uniting with the old, Using a flux, and proceeding by any of the methods described in this article. Regarding the use of the old metal for relining the shell, it may be pointed out that there is a limit to the number of times any grade of babbitt or white metal can be satisfactorily used; and if the history of the bearing is not known, or if the particular bearing is of importance, it will be the better policy to discard the old metal and use new. Old babbitt metal can be used, providing it is mixed with new, preferably, of course, of the same brand, in the proportion of three parts of new to one of the old.

The sizing of the linings is another important matter, several methods being used. In one method the bearing lining is cast upon a mandrel of the same size as the shaft upon which it will be used, and if all operations are carefully carried out this method is capable of giving good results. The linings are in some instances cast small to allow for fitting, by scraping, or by turning. This method should be avoided wherever possible, because the scraped or turned surface is not anywhere near as good as the chilled surface of the lining in its wearing qualities.

The third, and the best method of all, is the casting of the lining a few thousandths small, depending somewhat upon the diameter, chilling the metal as previously described, and then forcing a sizing burnisher through the bearing. In some instances the burnisher is merely a mandrel very slightly tapered for about one-half its length, the other half being the exact size required of the finished bearing. The burnisher should not be shorter than one and a-half bearing lengths; and the better the finish on the mandrel, the better the bearing surface produced. in this method the material is compressed to size, giving a hard, dense, mirror-like surface, absolutely devoid of pores or pinholes.

Machinery Magazine – January 4, 1923

Bearings may be divided into two classes: those having two elements — sliding surface bearings; and those having three elements — rolling surface bearings. The first class only (sliding

bearings) will be considered in this article. In discussing the design, construction, and lubrication of bearings, the fundamental laws relating to them, as discovered by a number of investigators in the past, should be taken into consideration. In the light of these laws, the ten principles following may be considered as definitely established for the operation of a properly designed, constructed, and lubricated bearing.

(1) The bearing surfaces are completely separated by a supporting film of oil.

(2) The friction of operation is the fluid friction in the oil film, and adequate thickness of film is essential.

(3) During construction, proper clearance or space should be provided for the normal thickness of the oil film.

(4) The advance edge of a bearing surface must be rounded off or chamfered in order to permit a supporting film of oil to form.

(5) The oil film forms most effectively upon a bearing surface whose advance edge is at right angles to the direction of motion.

(6) An increase of speed increases the thickness of film, all other conditions remaining constant and clearance permitting.

(7) An increase in the viscosity of the oil increases the thickness of film, other conditions remaining constant and clearance permitting.

(8) The larger the unbroken area of oil film, the greater will be the average pressure-supporting capacity per unit area, other conditions remaining constant.

(9) Every unnecessary oil groove or interruption in the continuity of the oil film reduces the supporting capacity of the film.

(10) For every bearing condition there is a film thickness corresponding to maximum lubrication efficiency.

The Action of a Journal in a Bearing

Let us assume that we have a journal 3 inches in diameter with a clearance of 0.004-inch. The centre of the journal will then be able to describe a circle 0.004-inch in diameter, and will also be able to assume any position within the circle. Now, let the diameter of the outer circle of Fig. 1 be equal to 0.004-inch; it will then be possible to plot all the movements of the centre of the journal within the circle. After lubrication, set the journal in motion in the direction of the curved arrow, without having any load on it (not even its own weight); the centre of the journal will then assume a position in the centre of the circle with an oil film of even thickness throughout. Now, maintaining the rotation of the journal and gradually applying a load in the direction of the vertical arrow it will be found that the centre point of the journal will move along a line making an angle of 72 degrees with the vertical, as the load gradually increases. This may be called the load line,

which is followed a distance equal to one-fourth the amount of clearance, or, in this case, 0.001-inch. Here the oil film is ruptured and the maximum carrying capacity of the bearing will have been reached. When a bearing is at rest, the loaded journal will be in metallic contact with the bearing at the lower point of its vertical diameter. As rotation begins, rolling of the journal upon the bearing occurs and continues to a point called the angle of repose, where slipping commences and the oil film begins to form. From here it follows the curved line and then assumes a position upon the load line corresponding to the amount of load that it carries.

Arcs of Maximum and Minimum Pressure

The location of the arcs where the maximum and minimum pressure on the oil film occur is of commanding interest. In the foregoing illustration, as the load is being gradually applied, a maximum pressure begins to develop at a point 10 degrees from the foot of the vertical diameter (measuring all degrees in a counter-clockwise direction), and as the load is increased this point gradually shifts to 45 degrees, while the intensity of the pressure increases from zero to the point of rupture of the oil film. In the same manner, a minimum pressure begins to develop at 184 degrees, and as the load is increased it gradually shifts to 125 degrees as the minimum at rupture, and its value changes from atmospheric pressure to a distinct suction.

The law governing the proper thickness of oil film has not yet been investigated to the extent that the importance of the subject demands. In modern machinery the average thickness of film varies from 0.0002 to 0.006-inch.

An Example of Proper Supply of Oil

Specific examples will best illustrate the application of the known laws of lubrication. Fig. 2 shows what may be considered ideal conditions, indicating a practical and efficient method of lubricating a crank-pin bearing where the journal receives oil

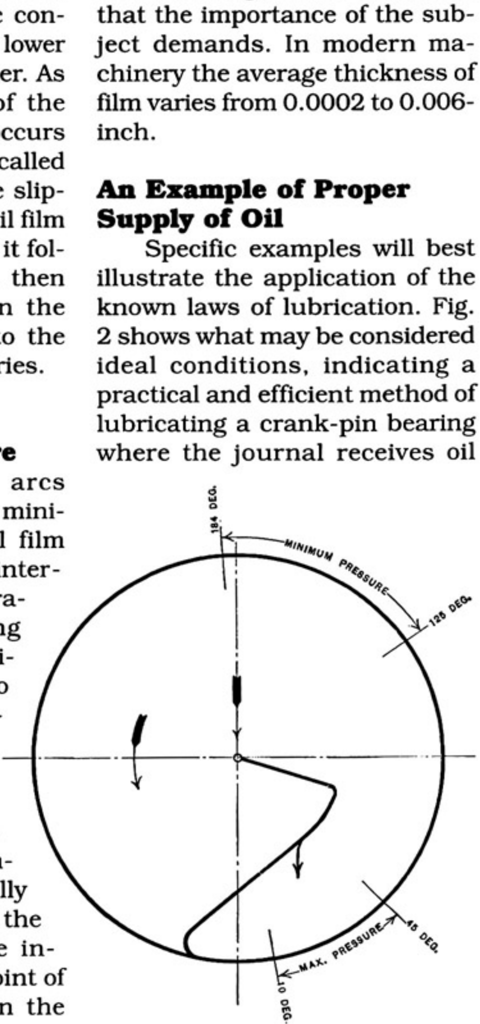


Fig. 1. Diagram showing Action of a Journal in a Bearing

through the crank pin. The rotation of the crankshaft is indicated by the upper arrow, and in the position shown the engine is on a dead centre, at a point of reversal of pressure. The direction of relative motion of the rubbing surfaces is shown by the two arrows at the right of the figure. The oil film enveloping the right half of the crank pin has been completely restored during the stroke just finished, since the oil groove passed over this half of the bearing while no pressure was being exerted on it. After the dead centre has been passed, the entire pressure is exerted on the crank pin with its fully restored oil film, and at the same time the oil groove wipes over the other half of the bearing and restores its oil film while no pressure is being exerted on it, after which it, in turn, is ready to receive a reversal of pressure on a fully restored oil film. Thus both halves of this bearing present alternately, for the maximum. pressure of each stroke, a complete and uninterrupted surface for maintaining the film on an area equal to the projected area of the crank pin; but it is impossible to obtain so perfect a condition of lubrication in a bearing having the old-fashioned cross oil grooves, which are still too often found.

In case the direction of rotation of the engine is to be reversed, the oil groove in Fig. 2 should be placed diametrically opposite its present position. The function~ of the oil grooves is to supply oil; in many cases they are necessary evils which should be minimized as much as possible by avoiding a useless excess of grooves, especially in the arcs of maximum pressure, as shown in Fig. 1. Unless good and sufficient reason exists to the contrary, oil grooves should be cut parallel with the journal.

Objections to Excessively Tight Bushings

The method by which bearing bushings are driven in is of great importance. Either because of neglect, or because the subject is not properly understood, bushings are sometimes driven in too tightly. All bearing alloys have a temperature coefficient of expansion higher than that of cast iron. The bearing bushing is also directly subjected to the friction of the journal, and hence its temperature is higher than that of the cast-iron housing surrounding it. For this reason, all bearing bushings must be allowed an opportunity for an appreciable outward expansion when in operation, and they should be driven in place with just enough pressure on the outside of the bushing to prevent it from coming loose while in operation.

The practice of driving in bushings so tightly that they must be reamed before they can be put into service is very objectionable. Subsequent reaming does not remedy the evil because a bushing driven in so tightly will continue to contract inwardly when it expands in operation, since the pressure on the out-

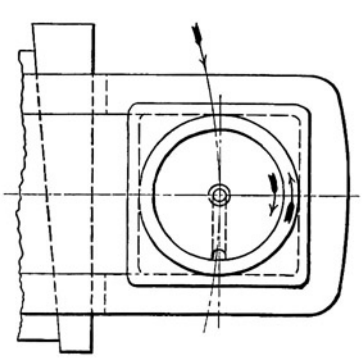


Fig. 2. An Example of Proper Conditions for Lubrication

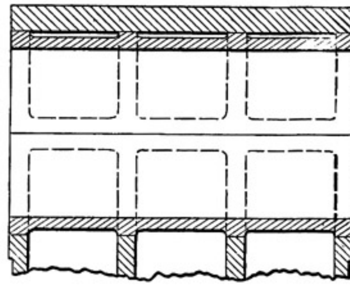


Fig. 3. Bearing with too Thin and Weak a Bushing

side prevents it from expanding in that direction. If a bushing is driven in too tightly, the amount of clearance between the bearing and the journal becomes a matter of guess-work, and the oil film space provided is uncertain. This is true even though the bushing has been reamed before being placed in service, and is a frequent cause of heating and bearing troubles. Any provision made for fastening the bushing in place should be such that it will not bind or clamp the bushing against outward expansion. If a set screw is used, for example, it should be provided with a turned down cylindrical end, engaging a hole in the bushing, but it should not bind or bottom in the hole.

Designing Bearings for Strength

Fig. 3 shows a bearing used in an established design of a well-known machine which gave trouble from the very first. It is provided with a split bronze bushing, 12 inches long, supporting a journal 6 inches in diameter. The maximum thickness of the bushing is 3/8-inch and it is recessed on its back to a depth of 1/8-inch as shown, leaving a thickness for the larger part of the bearing of only 1/4-inch. The cap of the bearing is held down by ten 5/8-inch studs. It is obvious that by clamping this bearing, the bearing surfaces are materially distorted by the pressure resulting from the tightening of the ten nuts. It is also apparent that the thickness of the recessed and unsupported part of the shell is not sufficient to withstand distortion under a normal oil film pressure. The trouble was, therefore, due entirely to the fact that the design is too light, since an examination of this bearing, after a short service, showed that the journal had scored along four circumferential lines corresponding to the four supporting edges beneath the bearing.

Design of Ring-oiler Bearings

Mention should be made here of another class of bearings which, together with their supports, are often improperly designed, namely, self-oiling ring bushings. These are nearly cut in half at mid-length in order to provide space in which the ring may operate, and the supporting wall beneath the bushing is slotted correspondingly at or near the centre to permit the insertion of the ring into the oil well. This often weakens the bearing unduly at a point where the greatest film pressure is normally exerted. In general, much of the trouble at present encountered in bearings can be overcome by simply increasing the strength and rigidity of the bearings and their supports, since a very small amount of distortion and deflection is sufficient to result in serious bearing troubles.

Machining Bearings

The manner in which bushings are clamped during machining is of great importance. They should not be clamped by a screw bearing on the outside cylindrical surface of the bushing. This is likely to distort it. Bushings to be machined should be clamped endwise. The importance of this is often underestimated, but it is only by holding the bushing by endwise clamping that distortion can be avoided. If bushings are clamped by screws bearing down on their cylindrical surface, it will often be found that after the bushings have been bored and the pressure released, they are far from round, and if they are then driven on an arbor and finished on the outside, the resulting product is very unsatisfactory.

Chamfering the Edges of Oil Grooves

The edges of oil grooves should be rounded off or chamfered, and this work should be done last, after all the other machining work on the bearing has been completed. Any machining after the oil groove edges have been chamfered is likely to produce a very sharp edge on the oil groove, which would prevent the formation of an adequate oil film and should be avoided.
By rounding or chamfering off the edge the very last thing, this difficulty is overcome.

Importance of having Sharp Tools for Machining Operations

It is very important that bearing surfaces be machined with sharp tools having rake. This is true, not only of lathe tools, but also of reamers or other cutting tools used for finishing bearings. It is evident that a tool without rake produces a normal or radial pressure on the bushing far in excess of the pressure produced by a tool having adequate rake; also a dull tool exerts much greater pressure than a sharp tool. In the case of a reamer having, say, fourteen cutting edges, the amount of bursting or internal pressure exerted within a bushing will be

very great if the edges are dull and without rake. The practice of using improper tools for this work cannot be criticized too severely.

The best practice for the final finishing of bearings is to use reamers or cutter-heads having only one or at best a very few cutting edges with a proper amount of rake, such as would be given to a proper cutting tool in a lathe. As pointed out by the author in a paper read before the American Society of Mechanical Engineers, experiments made in a large manufacturing plant on bushings of the same dimensions, produced from the same lot of material, finished at the same time — some, however, being reamed with the standard multiple cutting-edge reamer and others with a single cutting blade — showed that after being stored six months those bushings that had been reamed with a proper single cutting edge retained their accuracy and shape much better than those finished with the so-called "standard" reamer. The latter bushings exhibited a decided tendency to decrease in inside diameter and to assume elliptical forms. It was also brought out at this time that not only a superior product resulted from the use of a proper tool, but that by its use the production could be increased from 15 to 20 per cent.

An additional reason that bearing surfaces should be machined with sharp tools having the proper amount of rake is brought out by a microscopic study of bearing surfaces. In order to obtain the full bearing value of bearing alloys, it is necessary that these alloys be presented as bearing surfaces having their natural crystallization undisturbed. The mutilation, by improper machining, of' the bearing surfaces gives rise to the crushing of the harder crystals and then embedding these crushed particles into a compressed material, which does not permit the natural functioning of a bearing alloy.

Characteristics of Bearing Alloys

It is well known that a single homogeneous metal is not suited for bearing purposes, but that the first requirement for a bearing metal is an alloy composed of at least two metals, or a metal and a metalloid which should have at, least a limited degree of solubility while in the molten state; but upon cooling the alloys should partially separate into dissimilar crystals, and thus form the proper microstructure which is necessary in all bearing alloys.

The need of having a proper microstructure in a bearing alloy is always of far greater importance than its exact aggregate chemical composition. The value of an exact or definite chemical composition is secondary in that it can only serve in producing the desired microstructure in a given alloy, provided the alloy is subjected to the proper cooling conditions. The essential characteristic of all bearing alloys is a

structure made up of alternately hard and relatively soft microscopic particles intimately mixed. The function of the hard particles of bearing crystals is to support the load and resist wear; these bearing crystals should not be hard enough to prove distinctly abrasive to the journal surface. General experience shows that an extreme hardness of the bearing crystals is characterized by excessive wear of the journal. The function of the softer crystals is that of being plastic and of permitting the bearing crystals to adjust themselves to the surface requirements of the journal. These softer crystals are also more readily abraded and, therefore, wear slightly below the surface of the bearing crystals and thus form slight depressions on the bearing surface which serve to retain the lubricant. However infinitesimal in amount this may seem, nevertheless it is this lubricant that prevents scoring or seizing when the journal is starting up from rest at a time when actual metallic contact between the bearing surfaces exists. The same is equally true under an excessive load. This function of retaining a slight quantity of the lubricant on the bearing surfaces when metallic contact exists, characterizes a bearing alloy in its truest sense. Therefore, a bearing metal may be defined as an alloy that is capable of retaining a lubricant on a bearing surface.

In the operation of a bearing under normal conditions, when a continuous and unbroken film of lubricant exists, it matters little what metals are used while the film is sustaining the entire load. In the starting and stopping of the journal, however, or at all times when the film is interrupted and metallic contact exists, it becomes very important that the properties of a bearing metal should be present.

Hardening of Journals

Steel journals which have been hardened for bearing purposes should have hardened surfaces of an appreciable depth — a depth which is sufficient to permit grinding or polishing of these surfaces without actually cutting through the hardened portion. It is self-evident that a surface of insufficient thickness will present a bearing surface of uneven hardness after polishing or grinding. Unsatisfactory results invariably follow in such cases. The hardening of journal surfaces should be done by the pack-hardening process, and enough time should be allowed in the heating to produce a hardened layer of sufficient thickness. The old-fashioned cyaniding process should never be used, because such surfaces, after polishing or grinding, are of very uneven hardness, and general experience shows that this process leads to a great deal of bearing trouble. In cases where a general heat-treating process is resorted to, and where a uniform hardness is produced throughout, the foregoing objections, of course, do not obtain.

Grinding of Journals

Due precautions should be exercised when bearing surfaces are being ground, to prevent any of the abrasive from being left embedded in the surfaces. This, in general, applies to all bearing materials, but is more particularly of importance in leaded bronzes. For the grinding of bronze bearing surfaces, silicon carbide wheels should not be used, owing to the cleavage of this material, which forms long spicules that tend to embed themselves in the ground surfaces. For this class of grinding the author has found fused aluminium oxide wheels, including natural emery wheels, to give the least difficulty. It is very important to see that all ground bearing surfaces are free from abrasive material before they are put into service.

Standard Babbitt Specifications

MACHINERY MAGAZINE – FEBRUARY 22, 1923

The U.S.A. Society of Automotive Engineers has published standards adopted by the society for various types of babbitt. These specifications are given below. The limits for the chemical compositions specified for metal in ingot form are closer than the limits specified for cast products, as allowances have been made for unavoidable variations in the chemical content due to casting. All compositions are given in percentages.

SPECIFICATION FOR NO. 13 BABBITT

	Cast Products.	**Ingots.**
Tin	4.50 to 5.50	4.75 to 5.25
Antimony	9.25 to 10.75	9.75 to 10.25
Lead, maximum	86.00	85.50
Copper, maximum	0.50	0.50
Arsenic, maximum	0.20	0.20
Zinc and aluminium	None	None

This is a cheap babbitt and serves successfully where the bearings are large and the service light. It should not be used as a substitute for a babbitt with a high tin content. It is also .suitable for die castings.

SPECIFICATION FOR NO. 14 BABBITT

	Cast Products.	**Ingots.**
Tin	9.25 to 10.75	9.75 to 10.25
Antimony	14.00 to 16.00	14.75 to 15.25

Lead, maximum	76.00	75.25
Copper	0.50	0.50
Arsenic, maximum	0.20	0.20
Zinc and aluminium	None	None

This is a cheap babbitt and serves successfully where the bearings are large and the service light. It should not be used as a substitute for a babbitt with a high tin content. It is also suitable for die castings.

SPECIFICATION FOR NO. 10 BABBITT

	Cast Products.	Ingots.
Tin, minimum	90	90.75
Copper	4 to 5	4.25 to 4.75
Antimony	4 to 5	4.25 to 4.75
Lead, maximum	0.35	0.35
Iron, maximum	0.08	0.08
Arsenic, maximum	0.10	0.10
Bismuth, maximum	0.08	0.08
Zinc and aluminium	None	None

This babbitt is very fluid and may be used for bronze-backed bearings, particularly for thin linings, such as are used in aircraft engines. It is also suitable for die castings. When finished bronze-backed bearings are purchased a maximum of 0.6 per cent. lead is permissible in scraped samples, provided a lead-tin solder has been used in bonding the bronze and the babbitt.

SPECIFICATION FOR NO. 11 BABBITT

	Cast Products.	Ingots.
Tin, minimum	86.00	87.25
Copper	5.00 to 6.50	5.50 to 6.00
Antimony	6.00 to 7.50	6.50 to 7.00
Lead, maximum	0.35	0.35
Iron, maximum	0.08	0.08
Arsenic, maximum	0.10	0.10
Bismuth, maximum	0.08	0.08
Zinc and aluminium	None	None

This is a rather hard babbitt which may be used for lining connecting-rod and shaft bearings subjected to heavy pressures; its wiping tendency is very slight. It is also suitable for die castings.

SPECIFICATION FOR NO. 12 BABBITT

	Cast Products.	Ingots.
Antimony	9.50 to 11.50	10.25 to 10.75
Copper	2.75 to 3.75	2.75 to 3.25
Lead, maximum	26.00	25.25
Tin, maximum	59.50	60.00
Iron, maximum	0.08	0.08
Bismuth, maximum	0.08	0.08
Zinc and aluminium	None	None

This is a relatively cheap babbitt and is intended for bearings subjected to moderate pressures. It is also suitable for die castings.

Machinery Magazine — August 16, 1923

In order to cast babbitt bearings in rough castings it is necessary to provide a means for holding the work securely while the mandrel for the hole is located in a true central position. The variety of casting design may often lead to the use of babbitting fixtures having special features. In this article a number of such fixtures are illustrated. All mandrels used are made over-size to allow for shrinkage. This may be from 0.005 to 0.010-inch on the diameter, depending on the size of the hole.

A sectional view of a thrust box for an elevator worm-shaft bearing is shown in Fig. 3, the babbitt lining being indicated in solid section. The fixture in readiness for pouring the babbitt is shown in Fig. 1; an extra arbor with stop-collars used at each end of the bearing hole may be seen in front of the fixture. The mandrel has a key at one end for casting an oil-groove and is reduced in diameter at the forward end to accommodate the three-piece sectional sleeve *A*, which is fitted around this reduced diameter to cast the clearance space *A*, Fig. 3, for the oil seal. The 1-inch wide slot *B*

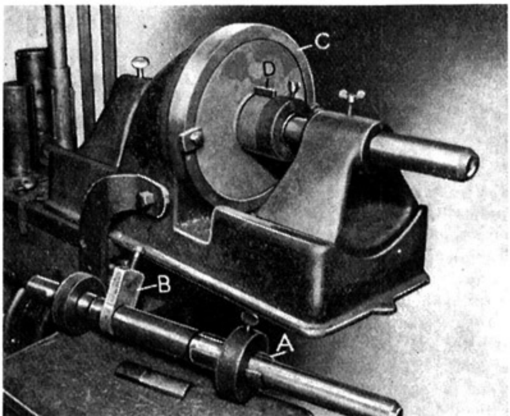


Fig. 1. Fixture used in babbitting Elevator Worm-shaft Bearing Thrust Box

is cast by a separate piece *B*, Fig. 1, through which the mandrel passes. This loose piece is located in the proper position by a keyway fitting over a key on the mandrel.

The casting has a 2 1/2 inch hole, a hub 4 1/2- inches in diameter and 10 5/16 inches long, and a flange 11 inches in diameter, The casting is cramped by means of a ring *C* in the fixture, which is interchangeable for different diameters of castings. It is located with the ridge *D* in a vertical position, so that the pouring hole cored near this ridge will be on top. The mandrel is passed through the central hole after the casting has been clamped in place, and the stop-collars are located at the front and rear, but are not fastened at this time to the mandrel. The cored opening for slot *B*, Fig. 3, is located vertically. The work-holding part of this fixture has an opening at the rear through which the loose piece for casting this slot is dropped into the cored opening in the casting, where it is centred by the mandrel which is passed through it.

The three loose sectional pieces for the oil seal are then fitted around the mandrel, as the extra mandrel in Fig. 1 shows, and the front stop-collar passed over them against the hub of the casting and clamped; the rear stop-collar is also fastened at this time. The front and rear bearing brackets for supporting the extending ends of the mandrel are then located in position on the base of the fixture. These have a circular base for convenience in moving them laterally into alignment with the mandrel. Finally, the mandrel is fastened in these bearing brackets by means of thumbscrews, and the casting poured.

During the pouring the operator watches the rise of the liquid babbitt around the loose piece for the oil slot (which is exposed to view), and when it overflows he stops pouring. At this time the cored pouring hole is also filled. To remove the work, the thumb-screws and clamps are loosened at the front and rear, the work with mandrel assembly removed, and the mandrel driven out by hitting it on the end. The split sleeve sections and the loose piece *B* then drop out.

The tapped hole and the two countersunk

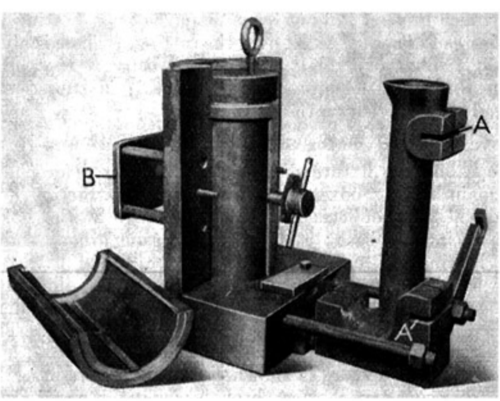
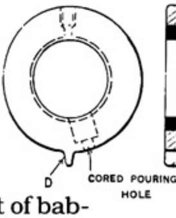


Fig. 2. Babbitting Fixture for Split Bearing Boxes for Elevator Drive Shaft

holes shown in Fig. 3 are machined after the bearing has been babbitted. Ridge *D* is chipped off on the dotted line to form a projection, from which any oil leaking from the end of the bearing may drip, instead of spreading all over the casting. There is always a slight amount of babbitt that escapes between the ends of the casting and the stop-collars and this is subsequently squared off by facing on the ends.



Fixture for Split Bearing Boxes

The babbitting fixture shown in Fig. 2 is used for pouring split main bearing boxes used in elevator construction. The cylindrical part of this fixture has a flange at the bottom which fits into the base; this provides for using other mandrels, when bearings of different diameters are to be cast. The lower half-box has a longitudinal oil-channel;leading to the oil-ring groove (see Fig. 4), and both. castings have 45-degree bevelled edges to form oil-grooves at the parting. These axe all cast by means of the fixed mandrel.

In Fig. 2 the fixture is shown before it is fully assembled so as to expose the passage through which the metal enters, and the pouring spout.

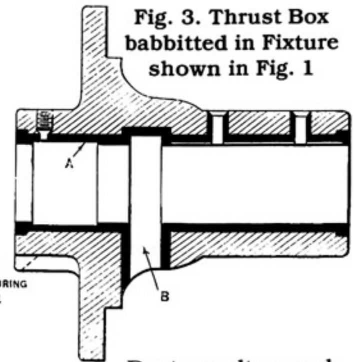


Fig. 3. Thrust Box babbitted in Fixture shown in Fig. 1

Best results are obtained in babbitting by pouring from the bottom,so that the metal will rise to the top. The pouring channel or gate is cut into the base of the fixture, and is covered by a strap. The pouring spout is split vertically and held together by clamps. These clamps are not shown in the illustration, but they swing in the slots *A*. The construction permits the pouring spout to be opened in case the sprue extends into it and prevents the work from being removed. The pouring spout is located so as to align with the gate in the fixture base, and fastened by means of a strap and two tie-rods.

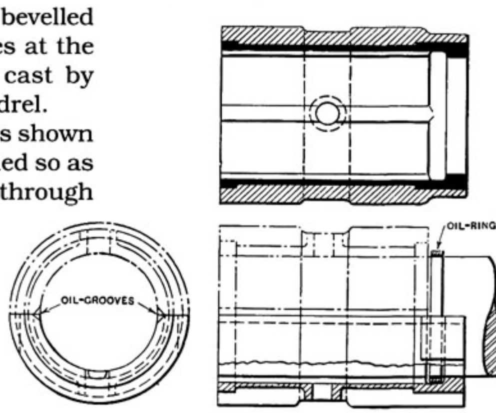
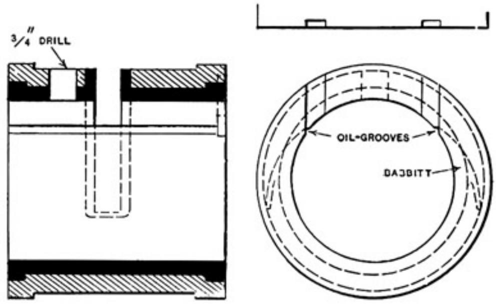


Fig. 4. Split Main Bearings babbitted in Fixture shown in Fig. 2.

Fig. 5. Solid Bearing Box babbitted in Fixture Shown in Fig. 6



The casting is located sidewise by two pins extending at each side, and is clamped by means of a pilot screw. The pilot screw also forms the 3/4 inch oil hole in each casting, and it carries a thick felt washer to seal the hole during pouring. A plate *B* carrying four ejector-pins is operated by a screw from the rear to remove the half-boxes after they are babbitted. The castings are faced on the ends to remove excess babbitt metal and finished. at the joint with a file so as to assemble tightly.

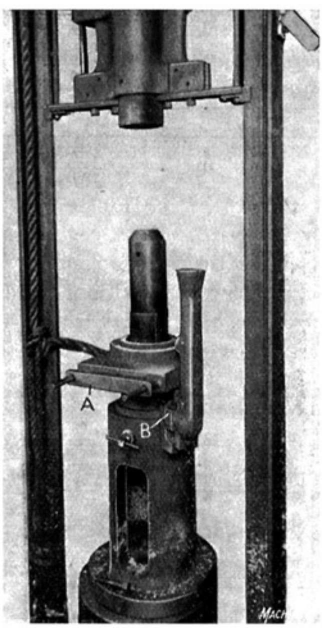


Fig. 6. Fixture for babbitting Bearing Boxes for Elevator Shaft

Fig. 4 shows the channels for distributing the oil, as well as the assembly of the upper bearing, the position of which is indicated by dot-and-dash outline. The oil channel is 5/8-inch wide and 1/8-inch deep, and extends into the oil-ring groove in the lower member. The upper member of the box extends only to this oil-groove, so that the ring may hang on the shaft as shown. The babbitting of the upper member of the box is identical with that just described, and is performed in the same fixture with the necessary mandrel.

A main bearing box for an electric elevator sheave shaft is illustrated in Fig. 5, and the fixture used in babbitting the lining in Fig. 6. This casting has two oil-grooves which are formed by projections on the mandrel, and a 3/4-inch slot for the oil-ring which is formed by an inserted piece having a semicircular end. The 3/4-inch hole in the box is drilled after babbitting, and the ends are faced as in previous examples.

In performing this operation the cylindrical fixture used is set on a table under a drop-hammer. This set-up is shown in Fig. 6 with The hammer in its elevated position, guided by the side rails of the supporting frame. The hammer is held in this position by a latch, and after the babbitting has been completed it is released to knock the mandrel from the work. The casting is located over a circular plate and the mandrel lowered into it by means of a hoist to a depth determined by the pilot screw shown at the front of the fixture. The upper part of the fixture consists of two hinged members which are swung together to enclose the casting. These have a slot in which the previously mentioned loose piece is inserted and brought up against the mandrel, where it is held while strap A is slipped over posts on the swinging members. This securely clamps the entire arrangement.

Piece *B* is then fastened to the side of the fixture. This piece contains the channel. or gate through which the metal is admitted to the bearing. The pouring spout is then bolted to this piece, the arrangement being similar to that described in connection with Fig. 2. This pouring spout is also split longitudinally and clamped together when in use. After the bearing has been poured, it is necessary to remove the pouring spout before the hinged members can be swung to release the work. When this is done, the hammer is dropped to remove the mandrel. Various sizes of these bearings are all handled on this fixture by the use of suitable mandrels and loose pieces for the oil-ring slot.

Babbiting Fixture For Small Bearings

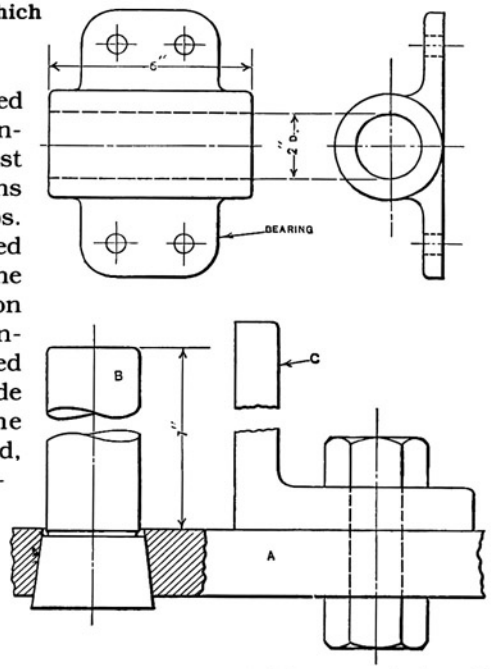
MACHINERY MAGAZINE – OCTOBER 29, 1925

An arbor press may seem out of place in a babbiting shop, but when small and medium sized bearings are being handled it can be of real service. Three hundred hand-truck axle bearings, like the one shown in the upper view of the illustration, were to be babbited to give a clearance over the axle of about 1/64-inch without machining. Instead of making an expensive babbiting jig, the following simple device was used:–

A tapered hole was reamed in the thick base plate *A*, shown in the lower view of the illustration. A steel mandrel *B*, which was to act as a core for the babbit, was fitted in this hole and wedged into place by being driven up from below. At a proper distance from the hole an angle plate *C* was bolted to plate *A*, and the whole assembly mounted on the table of a small arbor press, with the mandrel centred below the ram of the press. The upper part of the mandrel was made with a taper of about 0.003-inch in 7 inches, so that it could be drawn from the completed bearing.

In operation, a bearing cast-

Bearing, and Fixture in which it is held for babbiting



ing — previously warmed — was set over the mandrel and clamped against the angle plate by means of two small hand clamps. A ring of clay was worked around the bottom of the bearing where it rested on the base plate, and another ring of clay placed on the upper end to guide the flow of metal. The babbit, poured by hand, hardened in a few seconds; the clay was then broken away, the mandrel pressed out by the arbor press, and the completed bearing unclamped and removed. The whole process from the first driving up of the mandrel to the removal of the completed bearing required only a few minutes. By this method the operator and a helper produced thirty babbited bearings in five hours. The mandrel, warmed by a blow torch for the first bearing, was kept hot enough by each pour of babbit for each succeeding bearing

This method is useful in the small shop where jobs of this nature come in too seldom to warrant the purchase of special equipment. The mandrel is the only item that must be made, as the other fittings can be picked up around the shop. While the particular bearing described was rough and did not require machining, the same procedure is applicable to any job where the babbit is not to be poured under pressure. By making the mandrel a little smaller than the journal for which the bearing is intended, the bearing can be reamed out in the usual way.

F.M.W.

Oil Channels in Babbitt Bearings

AMERICAN MACHINIST MAGAZINE – JUNE 22, 1899

Editor American Machinist:

Some time ago I noticed a kink for making oil channels in babbitt bearings, that seemed quite as good as it was new to me. The bearings babbitted were

quite large, but the idea applies to any size. It is simply this: Select a piece of coarse cord as large as the desired oil groove, and wind it spirally around the babbitting arbor, reversing the spiral when the end of the desired groove is reached, and winding back to the starting point, where the ends may be knotted, if the cord is not too large or the box is poured one-half at a time, or they may be neatly bound together by a piece of strong thread.

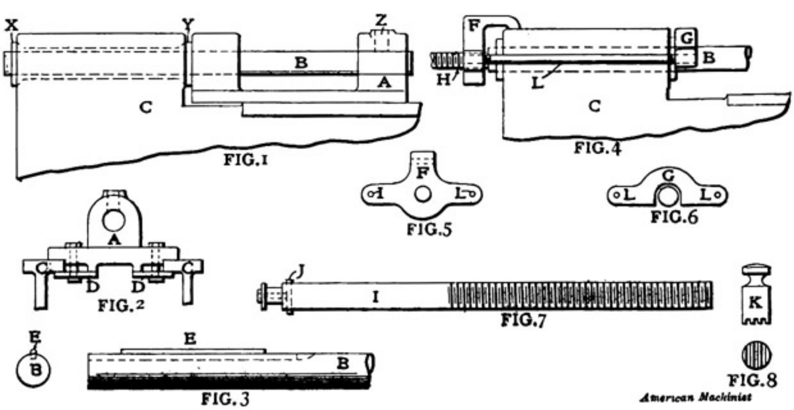
The cord used should be rather soft, in order that it may flatten out somewhat against the arbor and prevent the babbitt nearly closing over the side of the cord next to the arbor. The arbor is placed in the bearing and the metal poured in; and of course the cord forms a core which makes a clean groove much neater than they are generally chipped, and with far less work. If a straight groove parallel with the axis of the arbor is preferred a piece of cord may be fastened longitudinally to the arbor by moistening the ends of the cord in stiff clay water, pressing to the arbor and drying, or it may be bound in place by a piece of fine thread. We so often find grooves so small as to be clogged with grease and dirt; but with this scheme there would seem to be no excuse for lack of ample grooves, as it is as easy to put in enough all connecting as it is to put in only one...

Frederick M. Bush.

A Babbitting Device

AMERICAN MACHINIST MAGAZINE – NOVEMBER 11, 1905

The babbitting jig described is the result of a limited shop equipment and an effort to reduce shop cost. The bearing to be babbitted on bed *C*, Fig. 1, is solid, as shown, thus eliminating the planing and fitting of a split bearing and also doing away with the extra cap-screws. It was babbitted and bored with the fix-



A BABBITTING DEVICE.

ture because the shop at that time had no boring mill suited for the job. However, it has proven so satisfactory that even with a complete shop equipment I doubt if this method would be changed, as it is done so cheaply and makes so substantial a job that it seems hard to improve upon.

Babbitting bar *B*, Fig. 1, is held in the fixture *A*, which is in turn clamped to the bed *C* by the clamps *D*, as shown in Fig. 2. The collars *X* and *Y*, Fig. 1, are to retain the babbitt while being poured, the collar *X* having a gate to admit the metal. The babbitting bar *B*, Fig. 3, is slotted and fitted with the loose key *E*, which forms the oilway in the bearing. The key *E* is made the length of the bearing, but projects above the bar *B* for the length of the oilway desired only, and from there on the ends are turned down flush with the shaft. It is held in place by the collars *X* and *Y*. While bar *B* is being removed, the key *E* remains fast in the bearing, after which it is easily pulled down and out.

The device for removing the bar *B* – after the babbitt is poured – is shown at Fig. 4. The brackets *F* and *G* are held together by the rods *L*, these rods being threaded at the ends by opposite hand threads which are screwed into the brackets. When the device is in position, the bracket *G* rests on the bar *B* and the bracket *F* on the bed *C*, as shown. The bracket *F* is threaded to admit the screw *H*, which is squared at the opposite end for the use of a wrench or crank. The bar *B* is then forced out with the screw *H*. Figs. 5 and 6 are end views of the brackets *F* and *G*.

The bar *B* is made 1-16 inch smaller than the finished hole. After the bar is removed the bar *I* Fig. 7, is placed in the base *A* Fig. 1, and into the hole *Z* the pin *K*, Fig. 8, is dropped. The bar *I* is threaded with a square thread for a little greater distance than the length of the babbitted bearing. The pin *K* is grooved as shown to conform with the thread on the bar *I*, and when in place acts as a nut.

The pin *J* on the bar *I* is rounded on the ends, and is slightly longer than the diameter of bar *B*. This is run through the bearing, expanding the hole and compressing the metal, after which the pin *J* is removed and a cutter put in its stead, which roughs out the hole nearly to size. A reamer then follows, which completes the job. The reamer is placed on the end of the bar *I* – which is turned down – and is clamped against the shoulder with the screw and washer shown.

On first using the device we had trouble with the babbitt chilling when it struck bar *B*, which tended to make the metal full of holes and grooves. This, however, was overcome by pasting paper around the bar before pouring. Best results seem to be had by tilting the bearing to an angle of about 30 degrees. The bearing when finished is all that could be desired.

L.F.B.